THE

# FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 54 Thursday, January 9, 1936 No. 1012

# A Review of the Foundry Industry of 1935

THE statement issued from the International Labour Office at Geneva that unemployment has been reduced during 1935 throughout the various countries of the world with the exception of those on the gold *bloc* is confirmed by the articles we have received from prominent foundrymen throughout the world. It is satisfactory to note that the foundry industry is flourishing in the Dominions. South Africa, where the gold-mining industry is so busy that the largest mines are now working the most difficult seams, is indicative of the high state of prosperity, which has its repercussion on the foundry industry. The Standard Brass and Iron Foundries at Benoni have decided to erect a steelfoundry in co-operation with Edgar Allen of Sheffield. A serious shortage of skilled labour is reported, and it would not be surprising that an application is made in the near future for the engagement of a fair number of skilled moulders from this country. In Australia the foundry industry has continued to expand, and in New Zealand the erection of the first steelfoundry in that country is reported. Canada, this year, had the honour of entertaining the American Foundrymen's Association, and Mr. Anthes, a prominent Canadian foundryman, was honoured by the award of the Penton Gold Medal. Trade in the Dominions is unquestionably improving, and it is interesting to note from a study of their business newspapers that greater attention is being paid to co-operation with the United Kingdom. The Ottawa Agreements may be criticised by politicians, but one cannot help but notice that, since their introduction, greater interest has been taken by the Dominions in Imperial co-operation.

There has been a general improvement in trade conditions in Europe, and the last to feel the revival was Belgium, which country departed from the gold standard early last year. The three countries which can, unfortunately, point to no recovery whatsoever are France, Switzerland and Holland. The excellent report provided by Prof. Nilsson shows that Sweden is making splendid strides towards complete recovery, and, no doubt, this is shared by the other Scandinavian countries. A very important statement appears in his article where he deals with British coke. He complains of lack of uniformity in quality. We have noted in the past that whenever a Continental engineer has failed to effect promised fuel economies, when conducting some new cupola process, he has invariably put forward the excuse that British coke is of a definitely superior character to that usually employed on the Continent; so that to obtain a major benefit from this or that invention, a cheaper and lower quality of coke should be used. This authoritative statement by Prof. Nilsson should be examined with care by the British foundry-coke producers.

Italy, from which country this year for the first time we have no article, is, from the foundry point of view, extremely busy, and employment is increasing. Our readers will, naturally, regret the absence of an article from Dr. Guido Vanzetti, but will realise that the exigencies of the international situation make very heavy calls on his activities.

Both Germany and Czecho-Slovakia report much better trade conditions, and both Dr. Geilenkirchen and Prof. Pisek devote a fair amount of space in explaining the steps the foundry owners are having to take to eliminate price-cutting. In the former country, it has, apparently, been necessary to invoke the aid of the Government to ensure that a large section of industry is not ruined by the incessant price-cutting of irresponsible individual firms.

### Light Castings

Something of a boom has been experienced in certain sections of this industry. It is brilliantly organised from the employers' end, and, in this connection, the value of the work done quite voluntarily by a number of works' owners and executive officers on behalf of the industry as a whole is still insufficiently realised. It is not the first time that the industry has been well organised, but, on this occasion, the owners are taking steps to modernise the industry on well-planned lines. A notable event was the formation of a new combine, under the name of Federated Foundries, Limited. This is the second which has occurred during the last few years, and the fundamental principle actuating these moves is a knowledge that financial integration is probably the best means of ensuring the maintenance of prices at an economic level throughout the industry. The progress registered by Allied Foundries, Limited, is particularly welcome, as it is recognised that the industry it represents, being seasonal, demands a healthy export business in order that the foundries can be kept at a proper level of production throughout the whole year, and financial strength is a large factor in being able to maintain and improve the position of British manufacturers in the overseas market. In this connection, an international agreement is in being which relates to the marketing of baths. A certain amount of price-cutting still exists from the Continental side, but the State intervention, referred to above, is likely to regularise the position in the near future.

In connection with fitted goods—stove grates and the like—efforts are still being made to standardise the prices to be charged, and there is hope of an agreement in the near future. The position with respect to some of the castings sold to municipalities, such as manhole covers, is still unsatisfactory, and reports reach us which, the application of a minimum amount of elementary arithmetic shows are definitely uneconomic.

Flourishing trade conditions are reported by the manufacturers of gas cooking stoves, and the Radiation group have mechanised the works of John Wright and Eagle Range. A new model of gas fire has been placed on the market and the sales in the London area have, indeed, been extremely encouraging. This is in spite of the excellent progress which has been made by the electrical companies, which latter have received the contract for the heating of the new buildings for the University of London. The small portable wall-type electric radiator is increasing in popularity, and the foundries manufacturing these have been kept on full employment. Steady progress is being made by the manufacturers of electric cookers and incessant research work is in progress for their improvement.

### Pipe Foundries

Ten years ago anybody prophesying that the major portion of the output of pipe castings would be made by the centrifugal process would have been deemed to be extremely daring, yet such conditions now obtain within the industry. The system is being extended, and most of the large concerns are in a position to supply some form of spun castings. The perfection of these processes redounds the greatest credit to the foundry industry, and it is thought by many that the biggest concern in the trade can be credited with the appellation of the largest foundry in the world. The export position was approximately the same as in 1934, but the November figures showed some falling off in the larger sizes. There is still about between £40,000 and £50,000's worth of cast-iron pipes and fittings imported each year.

### Automobile Castings

The year just past has seen the creation of a new high level in the production of automobiles. The figure now stands at 403,720, a gain of about 60,000 over 1934. At a rough estimate, this will mean that something of the order of 3,000 tons of iron will be melted each week. A constant endeavour is made by these foundries to keep up to date, and it is no exaggeration to say that some of the larger ones have spent sums ranging up to £150,000 during

## CONTENTS


| | Page |
|---|---|
| A Review of the Foundry Industry in 1935... ... ... | 19 |
| The Progress of the Institute of British Foundrymen During the Year 1935 ... ... ... ... ... | 21 |
| The Enamelling Industry and the Institute of Vitreous Enamellers ... ... ... ... ... ... ... | 22 |
| Recent Developments in High-Duty Cast Iron ... ... | 23 |
| Foundry Equipment in 1935 ... ... ... ... ... | 24 |
| Conditions in the Non-Ferrous Foundry Industry in 1935 | 25 |
| The Steel-Foundry Industry in 1935... ... ... ... | 26 |
| The Light Castings Industry in 1935... ... ... ... | 28 |
| Recent Developments in the Light Alloy Foundry Trade... | 29 |
| The Malleable Iron Foundry Industry in 1935 ... ... | 31 |
| Refractories Industry in 1935 ... ... ... ... | 32 |
| Foundry Mechanisation ... ... ... ... ... | 33 |
| The Foundry Industry Month by Month ... ... ... | 34 |
| Recent Developments in Foundry Research ... ... | 35 |
| The Nickel Industry in 1935 ... ... ... ... | 36 |
| The Pig-Iron Situation in 1935 ... ... ... ... | 40 |
| Conditions in the American Foundry Industry in 1935 ... | 41 |
| The Czecho-Slovakian Foundry Industry in 1935 ... ... | 42 |
| The Foundry Industry in Sweden in 1935 ... ... ... | 43 |
| The Belgian Foundry Industry in 1935 ... ... ... | 46 |
| The Economic and Technical Position of the French Foundry Industry in 1935 ... ... ... ... ... | 47 |
| Irish Free State's Largest Foundry ... ... ... ... | 49 |
| The Position of the German Foundries in 1935 ... ... | 50 |
| Kawaguchi—The Falkirk of Japan ... ... ... ... | 52 |
| The Non-Ferrous Metals in 1935 ... ... ... ... | 54 |
| Metallurgical Research ... ... ... ... ... | 56 |
| This Week's News in Brief ... ... ... ... | 60 |
| Raw Material Markets ... ... ... ... ... | 62 |

the year on their modernisation. This year has seen the quantity production of cast-iron crank and camshafts. This represents a true gain to the foundry industry from wrought materials. There is also a tendency to revert to cast-iron brake drums to replace steel pressings. These developments represent a particularly interesting phase of metallurgical development, which is gradually expanding to embrace general engineering. The new method of cleaning the castings—by means of the airless rotating barrel, wherein chill shot is projected at high speed by centrifugal means—has found favour in one large automobile foundry, and its use seems likely to be extended during this year.

### Electrical Engineering

Satisfactory trade conditions have been experienced, both in the heavy and light branches of electrical engineering. Two of the foundries attached to the largest manufacturers have either installed a mechanised system or increased the capacity of their existing plant. The detached foundries, situated mainly in the Black Country, have been extremely busy making motor and switchgear castings for the South of England factories. The demand for electric hotplates, which are made from alloyed cast iron, has expanded and has arrived at such dimensions that the castings are being made on continuous plants.

### Jobbing Foundries

For the true jobbing foundry trade has been somewhat erratic. Though for the more serious orders the competition is now on a national basis, there still remains a large amount of work which, because of speed of delivery, is invariably carried out locally. The type of jobbing foundry to suffer most is that entering the category of "country." Until recently such foundries could depend on the local rural councils to provide them with a certain amount of work. The manufacture of municipal castings, however, is now gravitating towards the larger foundry especially laid out for their manufacture.

### Iron and Steel Works Foundries

This section of the industry has gained much with the increased output recorded by the large iron and steel works. The record production of steel ingots, made in 1929, has been overtaken during the last year. The largest single item of production from these foundries—that of ingot moulds—is at present the subject of a vast amount of research work, with a view to increasing their life in service. The contribution made by Dr. Swinden and Mr. G. R. Bolsover to the Annual Congress of the Institute of British Foundrymen, was of outstanding interest, and has awakened, throughout the mould makers of Europe, a desire to improve a product which, to say the least, has been of somewhat erratic character in the past. The roll foundries have also experienced improved trading conditions, and one located on the outskirts of Sheffield has had to undertake extensions to its foundry, though this enlargement is not necessarily due to the demands of the steelworks, but rather that of the rubber and paper industries. It is pleasing to note that, at long last, a large section of the roll industry is forsaking the rule of thumb for definite scientific principles. This departure is certainly tending to reduce the import of special rolls from the Continent.

### Shipbuilding

One would judge from a scrutiny of certain sections of the daily Press that shipbuilding is enjoying something of a boom; this is far from the truth, and though the number of shipyards has been drastically reduced since the termination of the war, yet the existing yards are only occupied to the extent of one-third of their capacity. Compared with three years ago, when only 50,000 tons of shipping was launched on the Clyde, certainly the present conditions do look healthy by comparison; but there is an infinite amount of leeway to make up before the 1913 position is re-established. International trade is but about 25 per cent. of its former dimensions; and, unless a vastly different policy is pursued by the majority of nations of the world, this percentage does not appear to have much chance of improving materially in the future. The Naval replacement programme, however, does offer some hope of amelioration in the trading conditions of those foundries which have devoted their energies for so many years to the production of marine-engine and shipbuilding castings. It is pleasing to record that the works of Darlington Forge is to reopen as soon as possible, and its famous steel foundry is again to be put into production.

### Mining

During the lean years, which are now happily passing, the stocks of castings normally carried by the collieries were reduced to a minimum, whilst the replacement programmes were kept at the lowest possible figure. Last year the management saw their way clear to increase their purchases, which benefited the foundries catering for them. The business in mining machinery was particularly brisk, and good business was reported by those firms which took part in a specialised exhibition of their products, held in Birmingham.

### Agricultural Implements

The complex section of the foundry industry can be interpreted to include the manufacture of small oil engines, sugar and tea machinery, dairy plant and sowing and reaping machines. In every section some improvement has been registered, and the general opinion is that the prospects are brighter for the current year. A pleasing feature has been the increase in buying capacity of the United Kingdom farmers, especially those engaged in the cultivation of sugar beet. It is pleasing to learn that Marshall's, of Gainsborough, since its reconstruction, is now enjoying excellent trading conditions; though, perhaps, it is the manufacture of road rollers which is contributing largely to their success.

### Textile Machinery Castings

Poor trading conditions are still unfortunately prevalent amongst the large number of foundries catering for this industry. Those situated in Yorkshire are distinctly better placed than the Lancashire group. The disappearance of such names as Hetherington from the list of active foundries is, indeed, to be regretted. There has, however, been a better tone abroad, and the Northrop Loom concern at least has had the courage to rebuild and re-equip its foundry.

### Printing

The foundries catering for the printing industry have been reasonably well employed. We were impressed, during the summer months, by a machine of the largest capacity which was erected and under test at a London works, prior to its export to South Africa. Such machines pay eloquent testimony to the skill of the engineer and the foundryman.

### Malleable Castings

A few years ago, Mr. A. W. G. Bagshawe stated that the consumption of malleable castings, per head of population, was lower in Great Britain than in any of the large manufacturing countries of the world. Whether this be the case to-day it is difficult to state, but, unquestionably, great strides have been made in production and practically all the more important concerns report that they are working at full pressure. The tendency to use rotary furnaces is gaining ground, and now these are to be found in most of the larger concerns using pulverised fuel, oil or coke-oven gas as the fuel. One large automobile foundry has successfully developed the production of malleable castings on a continuous system. This has much to commend it, as the saving in floor space and the easy organisation of the labour force is of outstanding importance. The usual batch system, unless a large number of furnaces are installed, involves the assembling of a large quantity of castings, ready for the annealing process, at the time when the furnace is filling up the floor space with the annealed product.

### Steel Foundries

It is pleasing to report that at long last this section of the foundry industry is no longer living upon its losses. The increase in trade has been definitely substantial, but the prices received for the products of the industry are still not commensurate with the skill and energy exerted. As it is easier for the British mentality to organise for the successful conduct of employers' federations when trade is good, rather than during the periods of depression, it is sincerely to be hoped that the steel-foundry owners will consider the present time opportune for the reorganisation of their employers' association upon lines which will withstand the disintegrating influences which, by nature, appear when trade begins to fall off. Commendable progress has been made in the development of alloyed steel castings, and an excellent appreciation of the situation was given by Dr. Hatfield to the Institute of British Foundrymen during the Sheffield Conference. Pulverised and oil fuel fired rotary furnaces have been adapted for use in steel foundries during the last year.

### The Non-Ferrous Industries

There has been a much improved activity amongst the majority of non-ferrous foundries, especially those making plumbing fixtures. The conditions for those catering for the marine and railway industries have improved and the prospects for this year are bright. A spare propeller has been made for the "Queen Mary" and has, after some little difficulty, been safely delivered at Southampton. This section of the industry was a little astounded to learn from a Paper given by Mr. F. Howitt that, after all, the control of sand is of much greater importance than had previously been deemed to be the case.

### Light Alloy Castings

There has been a steady development in this section of the foundry industry, with a distinct tendency to make die castings where economic conditions make it at all possible. The designers are taking an added interest in their potentialities as a means of reducing weight whilst conserving strength. So long as they maintain the situation within reasonable bounds they are on the right lines. Lightness can be overdone, and more than one car carries a load of pig-iron to maintain its steadiness on the road. The anodising of aluminium is now finding industrial as well as artistic applications. A London firm opened up a new die-castings department which has been reasonably well filled with orders.

### Foundry Equipment

All the foundry-equipment firms have been working to capacity, though because of the recent creation of some of them, much energy and time was absorbed in creating new works. The major activities have been devoted to the provision of mechanised plants, the new airless centrifugal shot-cleaning machines—a new development—sand-preparing and cooling plants, core-blowing machines and, of course, moulding machines. The last year also saw the placing on the market of new core-wire bending machines, a new type of flooring and specially-designed pattern racks.

### Conclusion

Last year was one of ordered progress throughout the whole of the foundry industry and its allied trades, and this year promises to register substantial gains in most sections. The important programmes announced by the Government spending departments and the railway companies are bound very materially to effect beneficially the foundry industry.

# The Progress of the Institute of British Foundrymen During the Year 1935

## By J. E. HURST (President of the Institute of British Foundrymen)

IN the Annual Report of the Institute of British Foundrymen presented at the Conference in Sheffield during the first week in July and published in the issue of THE FOUNDRY TRADE JOURNAL of July 5, details of the progress and activities of the Institute up to the end of April, 1935, were given. The short interval of time which has elapsed since the Sheffield Conference has witnessed several outstanding features in the activities of the Institute, namely, the Foundry Exhibition at Olympia and the International Foundry Congress, which was held this year in Belgium.

In connection with the former, by the courtesy of F. W. Bridges & Sons, Limited, a stand was erected and placed at the disposal of the Institute. The organisation of this stand with the object of displaying to the engineering trade in general the progress and development in the manufacture of castings, was undertaken by the Technical Committee. Exhibits were furnished by the various Sub-Committees and included alloy-steel castings, malleable castings, methods of gating and rising, recommended standard test-bars, sand-testing apparatus, samples of refractories, melting-furnace charts, costing sub-committee reports and various other items. This exhibit created a good deal of interest and was appreciated very much by visitors to the stand as an indication of the extent of the Technical Sub-Committees of the Institute. The work of these Technical Sub-Committees is progressing steadily and their organisation has been established and consolidated on a firm basis. In the case of the Sub-Committee dealing with sands and refractories, it has been found necessary to sub-divide this into two committees: one to deal with moulding sands as distinct from refractory materials which will be dealt with by a separate committee. This latter committee will operate under the convenorship of Mr. W. J. Rees, of Sheffield University, whose work in connection with refractory materials is widely known and appreciated. The Cast Iron Sub-Committee is in active co-operation with the British Standards Institution's Committee dealing with the consideration and drafting of specifications for cast-iron testing, thus still further consolidating the relations between the Institution and the Institute of British Foundrymen.

In connection with the activities not only of the various technical committees, but also of the main council, branch councils and officials and their various sub-committees, it cannot be too widely known that the Institute relies upon an immense volume of voluntary work and service. The individual members give freely and willingly of their time, knowledge and experience, and often travel long distances in attending meetings. This voluntary work and the enthusiasm that it represents is deserving of the widest possible recognition and support on the part of the whole of the foundry industry.

MR. J. E. HURST.

### The Brussels Conference

It is well known that the Institute of British Foundrymen maintains very close relations with similar organisations in the principal industrial countries of the world, through the medium of the International Committee of Foundry Technical Associations. The International Conference which was held in Brussels this year was attended by a delegation from this country of 30 members and their ladies, headed by the President of the Institute and the Senior Vice-President, and also by the President of the Foundry Trades' Equipment and Supplies Association, Mr. G. T. Lunt. The Conference was held within the International Exhibition with the Belgian Foundrymen's Association as hosts under the presidency of M. Léonard. The hospitality extended to the delegates from visiting countries was of a very high order and the whole proceedings will become memorable in the annals of the International Conferences. The value of these International Conferences in promoting the interchange of knowledge and experience between foundrymen of different countries is amply demonstrated by the published Memoirs of the Brussels Conference. Thirty Papers were presented, making up a volume of over 300 pages, and the authors were drawn from all the principal industrial countries of the world.

### The Sheffield Conference

At the Conference of the Institute in Sheffield in July, the Institute had presented to it a number of Papers of very high standard, both in connection with the specially organised symposium on Steel Castings and on general founding subjects. The works visited proved to be very interesting, and the proceedings were graced by a reception by the Lord Mayor and Lady Mayoress of Sheffield in the Town Hall, and by the Vice-Chancellor of the Sheffield University, Dr. A. W. Pickard Cambridge and Mrs. Pickard Cambridge, at the Sheffield University, who, in addition, extended an invitation to the Institute to hold the Conference within the University precincts. The thanks of the whole Institute are due to the Lord and Lady Mayoress, Alderman and Mrs. P. J. M. Turner, Dr. A. W. Pickard Cambridge and Mrs. Pickard Cambridge, the Reception Committee, the directors of the works visited, the subscribers to the Conference funds, and to the organising secretary, Mr. T. R. Walker, B.A., secretary of the Sheffield Branch of the Institute.

### Work of the Branches

One of the outstanding features in the Branch programmes for the year has been the repetition of the joint meeting between the London and the East Midlands Branches, held this year at Derby and Loughborough. The organisation of further joint meetings of a similar character between various Branches is deserving of every encouragement. There is a list of Papers presented to the Institute at the various Branches in the short statistical summary which accompanies this review. In connection with the Papers, it is of interest to note that there is an increasing tendency to read important Papers at more than one branch. This is an advantage, in that a larger number of people can hear at first hand these important Papers, and can

G2

THE INSTITUTE OF BRITISH FOUNDRYMEN.

*OFFICERS*, 1935–36.

PRESIDENT:
J. E. Hurst.

VICE-PRESIDENTS:
H. Winterton; C. W. Bigg.

PAST-PRESIDENTS:
R. Buchanan. (Deceased, 1924.) 1904–1905.
H. Pilkington. (Deceased.) 1906–1907.
F. J. Cook, M.I.Mech.E. 1908–1909.
P. Longmuir, M.B.E., D.Met. 1910–1911.
C. Jones. (Deceased, 1923.) 1912.
S. A. Gimson. 1913–1914.
W. Mayer. (Deceased, 1923.) 1915.
J. Ellis. (Deceased, 1930.) 1916–1917.
T. H. Firth. (Deceased, 1925.) 1918.
John Little, M.I.Mech.E. (Deceased, 1932.) 1919.
Matthew Riddell. 1920.
Oliver Stubbs, M.I.Mech.E. (Deceased, 1932.) 1921.
H. L. Reason, M.I.Mech.E. 1922.
Oliver Stubbs, M.I.Mech.E. 1923.
R. O. Patterson, 1924.
J. Cameron, J.P. 1925.
V. C. Faulkner, M.Inst.M. 1926.
J. T. Goodwin, M.B.E., M.I.Mech.E. 1927.
S. H. Russell. 1928.
Wesley Lambert, C.B.E. 1929.
F. P. Wilson, J.P. 1930.
A. Harley. 1931.
Victor Stobie, M.I.E.E. 1932.
C. E. Williams, J.P. 1933.
Roy Stubbs. 1934.

HON. TREASURER:
W. B. Lake, J.P.

TRUSTEES:
F. J. Cook, R. O. Patterson and A. Harley.

GENERAL SECRETARY AND GENERAL OFFICE.
T. Makemson, Assoc.M.C.T., St. John Street Chambers, Deansgate, Manchester, 3.

THE INSTITUTE OF BRITISH FOUNDRYMEN

*Members.*

| | |
|---|---|
| Honorary | 15 |
| Subscribing Firms | 49 |
| Members | 755 |
| Associate Members | 909 |
| Associates | 146 |
| Total | 1,874 |
| Branches | 10 |
| Sub-sections of Branches | 5 |
| Junior Sections | 1 |
| Committees of Council | 5 |
| Technical Committee and sub-committees | 9 |
| Branch meetings during 1935 | 118 |

The Institute is also represented on several kindred organisations.

*Papers presented.*

| | |
|---|---|
| Cast Iron | 15 |
| Steel Founding | 6 |
| Non-ferrous | 7 |
| Moulding, Coremaking and Patternmaking | 16 |
| Sands and Refractories | 10 |
| Furnace Design and Practice and Fuels | 7 |
| General Discussions | 8 |
| Organisation | 9 |
| Miscellaneous | 7 |
| Total | 85 |
| Nationalities represented in membership | 11 |
| Countries in which members are resident | 17 |

derive the benefit of discussion with the authors. The continuance of this policy will have an important effect in raising still further the standard of the Institute. The practice of reading reports of the Technical Sub-Committees before the various Branches has been continued and is recognised evidently as of great value.

### Exchange Papers

In connection with exchange Papers presented to Foundry Associations in other countries by our members, the Paper to the International Conference in Brussels was given by Mr. Beeny M.Met.; Mr. P. A. Russell, B.Sc., the Convener of the Cast Iron Sub-Committee presented the exchange Paper to the French Foundrymen's Association, whilst Mr. Murphy presented the exchange Paper to the Conference of the American Foundrymen's Association. At our own Conference in Sheffield, we received exchange Papers from the American Foundrymen's Association by Mr. Geo. Batty, from the German Foundrymen's Association by Mr. W. A. Geisler and from the French Foundrymen's Association by the late Mr. Fabre and Mr. Dubois.

### Educational Activities

In the realm of foundry educational work, the activities of the Institute have continued on the now familiar lines. The results of the City & Guilds examinations in Foundry Practice and Patternmaking are given in the next column.

All the certificates issued to the successful candidates were endorsed by the President of the Institute of British Foundrymen, making a total in four years of 216. In addition, 22 certificates were endorsed on behalf of successful candidates in the Union of Lancashire & Cheshire Institute examinations. Thirty-three National certificates in Mechanical Engineering were endorsed with reference to Foundry Subjects, making a total of 136 during the last four years.

The Foundry Degree Course within the Faculty of Metallurgy at the Sheffield University which was inaugurated at the request of the Institute of British Foundrymen is now in the second year. An increase in the number of students is reported and it may be expected that this will grow as it becomes more widely known. The value of this course has been stressed repeatedly and is clearly recognised. The Institute of British Foundrymen has already raised considerable funds, but more still are needed. The Institute of British Foundrymen has also given its support to the British Foundry School and maintains close contact with the British Cast Iron Research Association, and the British Non-Ferrous Metals Research Association.

| No. of Candidates. | Pass. | | Percentage of passes. | Grade. |
|---|---|---|---|---|
| | 1st class. | 2nd class. | | |
| 29 | 5 | 11 | 55.2 | Patternmaking Inter. grade |
| 21 | 6 | 8 | 66.6 | Patternmaking Final grade. |
| 61 | 13 | 21 | 55.7 | Foundry practice & Science |

In membership, this year has witnessed a slight increase due no doubt to the improvement in general conditions. Through the death of Mr. F. W. Finch, the Institute has lost its founder. The formation of this Institute was due to correspondence initiated by him in THE FOUNDRY TRADE JOURNAL in 1902. For some years he was Honorary Secretary of the Institute, and for over 20 years its Honorary Treasurer. In recognition of his activity and his long unbroken service to the Institute, he was awarded the Meritorious Services Medal in the year 1933. The Right Hon. Arthur Henderson, who became an Honorary Member of the Institute in 1926 has also passed away during the year. Himself a moulder, he always took a close interest in the Institute and as an Institute we have been proud to know that one of the leading statesmen of our time should have arisen from the foundry, and we have been honoured by his membership.

It is impossible to pass from a review of the membership of the Institute without a reference to the work of Mr. James Smith and Mr. Scott in the Newcastle Branch. With their return to harness renewed vigour has been infused into this Branch, and their services are deserving of the full appreciation of all the members of the Institute.

The employment register is still maintained with the active co-operation of THE FOUNDRY TRADE JOURNAL and perhaps this a fitting opportunity of conveying to the proprietors of this journal an expression of appreciation of the value of their services, not only to the Institute but to the whole of the foundry industry.

### The Future

In closing this brief review of the progress and activities of the Institute of British Foundrymen, a few comments on its future development appear to be permissible and desirable. It must be a matter for gratification on the part of all its members to realise what a flourishing and vigorous society the Institute of British Foundrymen has become. With its increased activities come increased responsibilities and in this connection the future policy of the Institute is worthy of earnest and careful attention on the part of those who have its interests at heart, with the object of maintaining and perhaps advancing still further the position it has created for itself amongst the metallurgical institutions throughout the world.

# The Enamelling Industry and The Institute of Vitreous Enamellers

## By W. H. WHITTLE (Chairman of The Institute of Vitreous Enamellers)

A LARGE number of new plants have been installed during last year, and additional new lines are creating plenty of work. More articles are being vitreous-enamelled than ever before, and, with the General Election disposed of, confidence has been maintained, there are definite signs that more and larger orders are being placed than was the case a year ago. Moreover, schemes that had been pigeon-holed are being reconsidered and materialised. So far as quality is concerned, overseas visitors to the British Industries Fair, who were specially well placed to pronounce authoritatively, were unanimous in their judgment that the finishes displayed could not be excelled in any European country.

### The Institute

The annual meeting was held at the British Industries Fair, and the attendance indicated that interest in the welfare and objects of the Institute was increasing rather than diminishing. At Whitsuntide most members of the Council visited Glasgow with the object of creating an interest in the affairs of the Institute in Glasgow. The firm of Shanks, of Barrhead, was visited, and a technical session was held. The interest evinced was such that a lecture programme has been arranged, and reasonably good audiences are assembling. The thanks of the Institute are due to Mr. Roberts and Mr. Daniel Sharpe for efforts they are making to inculcate the ideal of co-operation into the minds of their Scottish colleagues.

The next event of outstanding importance was a visit by a number of our members to the International Foundry Congress at Brussels. Here, due to the efforts of Mr. V. C. Faulkner, a special series of works visits was arranged, and the sincere thanks of the Institute are due to Messrs. Martin; Les Fonderies Bruxelloises, and La Société des Forges de Cinay for the cordial reception they accorded to our members.

MR. W. H. WHITTLE.

The annual convention was held in London towards the end of September at Olympia during the run of the Shipping, Engineering and Machinery Exhibition, by kind invitation of the organisers, Messrs. F. W. Bridges & Sons. The annual banquet and dance well maintained the high standard established at Birmingham in 1934. Mr. Charles Lloyd was the principal guest, and in his speech made an appeal for an ever widening co-operation between cognate industries. Messrs. Belling & Company, of Enfield, were kind enough to throw open their shops for inspection, an action especially appreciated by members of an industry which until the advent of the Institute invariably regarded its processes as secret. In this connection it is interesting to record that since the inception of the Institute, no less than ten works have been visited, and many others are scheduled for inspection in the future. The membership list now stands at 177, and 64 have been added during 1935. No less than eighteen lectures are down for hearing during the present session.

There is reason to believe that the registration of the trade sign will be announced during the next few months. Other major activities of the Institute have been in connection with the Import Duties Advisory Committee and the British Standards Institute.

A thoroughly bright future is confidently anticipated for both the vitreous enamelling industry and its representative Institute.

# Recent Developments in High-Duty Cast Iron

By P. A. RUSSELL, B.Sc. (Director, S. Russell & Sons, Limited, Leicester, and Convener of the Cast Iron Committee of the Institute of British Foundrymen)

THE term "High-Duty Cast Iron" is not at all clearly defined and may be said to include any form of cast iron that has properties considerably in excess of the requirements of Grade "A" cast iron as set out in the British Standard Specification 321, in which the highest tensile strength requirement is 12 tons per sq. in.

For many years a very great number of castings have been produced with a tensile strength of 14 to 16 tons per sq. in., including most of those produced under the ill-named title of "Semi Steel." It is now generally recognised that this material is only an improved cast iron, and may be said to comprise the first category of high-duty cast iron. This grade of cast iron is generally produced either by the use of mixtures containing steel or refined pig-iron, and the technique of its production is fairly clearly understood throughout the founding industry. Iron of this quality is now regularly demanded for important castings in all sections of the machine- and engine-building trade, and is particularly in demand for machine-tool and other castings, having important wearing faces, on account of the high Brinell hardness that is usually associated with cast iron of this grade.

In the same category cast iron produced by various patent processes such as the "Perlit" and "Emmel" may be placed. These irons came into great prominence about ten years ago, and almost immediately found extensive use in the marine-engine trade and other similar branches of industry. Apart from the strength factor, these irons are particularly valuable for their thermal properties and for their stability at moderately high temperatures. As such they are still deservedly popular.

### The Second Stage

The second stage in the development of high-duty cast iron came with the introduction of alloys, principally nickel and chromium. By the use of these the 14 to 16 tons per sq. in. tensile strength of the steel-mix or refined categories of cast iron may be raised to 16 to 18 tons per sq. in., and the falling off of strength in thick sections may be diminished. It is, of course, possible to obtain this increase in strength without the use of alloys, but by using alloys the results are much more certain and regular. This higher strength is again associated with higher Brinell hardness, whilst maintaining machinability, and it is in castings subject to wear, or that require a great degree of uniformity, that alloy cast irons are principally employed. Machine-tool parts, cams for actuating various types of machinery, such as looms and shoe machinery, dies for the press-tool trade, pumps, Diesel and motor-vehicle engine cylinders, brake drums, are typical examples of applications of nickel-chrome cast iron, and many progressive firms have now standardised this material for such parts.

### The Third Category

It is, however, upon a third category of high-duty cast iron with a tensile strength of 18 tons per sq. in. and over that interest is particularly focused at the moment. In the present stage of our knowledge of cast iron it is practically impossible to produce this third grade of cast iron without some form of "processing" or heat-treatment.

The best known and most fully developed of these processes is that carried out under the

MR. P. A. RUSSELL, B.Sc.

"Meehanite" patents. This process originated in the United States of America, but there is now a considerable number of licensees in this country and on the Continent of Europe. Apart from the special process, commonly known as "inoculation," that enables high strengths to be obtained, Meehanite methods involve a system of close and exact control, and it is claimed that if certain qualities are called for they can be obtained, and foundries can put forward guarantees with every confidence, guesswork being eliminated.

There are a number of grades of Meehanite; the five major grades designated A, B, C, D and E, have tensile strengths ranging from 16 tons per sq. in. for Grade "E" to 25 ton per sq. in. (min.) for Grade "A." The fatigue and impact strengths of Grade "A" are claimed to be two and six times, respectively, greater than those of ordinary cast iron. In addition, special grades of Meehanite are produced to meet conditions of heat or corrosion resistance.

An alternative process to Meehanite, also based on the principle of inoculation, is Ni-Tensyl. This is also a patent process and is again of American origin, but is now being developed in this country. This material contains a proportion of nickel, which gives added benefits. This process is confined to the production of irons of 20 tons per sq. in. and over, the lower grades being taken care of by the ordinary nickel-chrome cast irons, and the heat and corrosion resistance by alloy irons of various types. A very important feature of inoculated cast irons is their uniformity of structure and strength throughout varying sectional thicknesses.

It is, however, possible to produce cast irons of 18 tons per sq. in. and over without having recourse to either of the patent processes referred to above, and a number of foundries in this country are producing such irons. The method usually employed is the use of special types of melting furnace, such as the electric or rotary furnaces, thereby obtaining close carbon control and superheat. The products of these methods are usually for specialised purposes and very little data are available as to the actual results obtainable. Other methods, such as the production of fine graphite by jolting the bath of molten metal or the control of structure by gas reactions, are proposed, but, so far as the author

A SECTION OF THE FOUNDRY OF MESSRS. S. RUSSELL & SONS, LIMITED, WHICH HAS BEEN SPECIALLY EQUIPPED FOR THE PRODUCTION OF HIGH-DUTY IRON CASTINGS.

is aware, these methods have not yet been commercially applied in this country.

The processes involving inoculation referred to above are probably the simplest methods of obtaining high-duty cast iron of this third category, and it is in the development of these that the author anticipates that most progress will be made in the immediate future.

### Heat-Treated Cast Iron

A further development is in the heat-treatment of cast iron. All the grades of cast iron that have been discussed are capable of improvement, both as regards strength and hardness, by heat-treatment, but it is apparent that the higher the grade of cast iron, the more susceptible it is to heat-treatment and the risks attendant upon heat-treatment are reduced. A gain in strength of about 50 per cent. can be obtained by suitable heat-treatment of inoculated cast iron, with a corresponding increase in hardness. A remarkable feature of these heat-treated irons is that Brinell hardness of over 300 can be obtained, whilst the material remains in a machineable condition. Much higher hardness can be obtained by sacrificing machinability.

The commercial development of this third grade of high-duty cast iron seems to be lagging behind the technical development, but this lag will undoubtedly be made up as soon as the remarkable properties obtainable from these irons are fully realised, and certain experimental applications have been thoroughly tested out. The development should be rapid when it is fully realised that a cast iron is available that has a tensile strength approaching that of mild steel, but which retains the feature of rigidity which is desirable in so many applications, combined with the facility for casting into intricate shapes, and a reasonable cost.

The most spectacular application of this grade of iron is the development of the cast-iron crankshaft, which is now a standard feature of several well-known makes of car produced in this country. In this instance, the cast-iron crankshaft is claimed to be definitely superior to mild steel, apart from considerations of cost.

Other applications are extensions of those given for the second category, in which strength and resistance to wear are the principal considerations. Dies for metal pressing and piercing, which can be cast to within close limits, and costly machining eliminated, form one of the principal sources of demand.

Cams, gears, flywheels, crusher frames and various machinery parts are all being regularly produced in this type of iron, whilst the harder grades are particularly suitable for conditions of severe abrasive wear, such as crusher jaws and cement mixers. Malleable castings are also being replaced in certain instances where strength but not malleability is required.

In view of the development in cast iron since the introduction of Specification 321, it is felt that a new specification is required covering these high-duty cast irons, and a Committee of the British Standards Institution is now considering this.

In conclusion, no article on this subject would be complete without reference to the many special grades of cast iron that have been developed for specific purposes and which, whilst they are not all high duty in the sense of strength, are giving very good service in their respective fields. It is not possible to detail all of these, but the principal types are as follow:—Centrifugal castings for liners, piston rings and pipes, all showing good strength properties; chromium and silicon irons for heat resistance; austenitic irons for heat and corrosion resistance; martensitic irons for very high hardness; and special alloy irons for chilled rolls.

# Foundry Equipment in 1935

## By G. T. LUNT (President, Foundry Trades' Equipment and Supplies Association)

IT is much to be regretted that no official statistics are available in this country of the position of the foundry equipment industry, and in any attempt to review the trade during the past year one must rely very largely on personal observation and scraps of gossip gleaned from contact with plant manufacturers. I am informed that in America they collect and publish figures showing the values of foundry equipment sold and delivered and that these statistics are regarded as of fundamental importance in the forecasting of trading conditions. I feel sure that closer co-operation between foundry equipment makers in this country would from this and other points of view be of definite advantage to the industry.

The chief event during the year now past was the holding of a Foundry Trades Exhibition at Olympia in the Autumn in conjunction with the Shipping Engineering & Machinery Exhibition. It is to be regretted that the Foundry Section, while of reasonable size and representative of the industry, was not large enough to show the great strides that have been made since the previous exhibition was held. I would like to refer here to a suggestion put forward at the Inaugural Luncheon, that an attempt be made to obtain the co-operation of makers of foundry products. I believe that it would be of inestimable benefit to the whole of the foundry and allied trades if it were found possible to stage at Olympia in 1937 a comprehensive range of foundry supplies, foundry plant and equipment and foundry products, the latter section to include not only finished machines, but the actual raw castings as made and sold to the engineer buyer. Makers of castings for the trade would thus have the unique opportunity of participating in a comprehensive exhibit and making direct contact with their engineering markets.

I hope this suggestion will be taken up by the various trade organisations and associations, as it holds great possibilities of bringing to the front the enormous progress and importance of the whole foundry industry.

### New Machinery and Plant

Last year heralded the introduction of two types of airless chilled iron shot blasting machines, the Wheelabrator and the Sand Wizard. The firm manufacturing the former type, put in hand a batch of eight, all of which have been sold to the foundry industry, whilst the latter also reports good progress. A foundry concern in the West Country has decided to market a well-designed pattern rack, whilst a London concern is offering a new type of grid flooring for foundries.

MR. G. T. LUNT.

### Mechanisation

As a special article is to be devoted to this phase of foundry equipment, it should suffice here to say, that one large mechanised foundry has spent during the year about £150,000 on extensions and new plant, whilst either new foundries or large-scale additions have been made by Wingets of Rochester; Rustons of Lincoln; G.E.C. of Witton; Combustion Engineering Company of Derby; Newman Hender at Woodchester; John Wright and Eagle Range of Birmingham; the Metropolitan Vickers Company of Trafford Park, and Babcock & Wilcox of Renfrew.

### Moulding Machines

Apparently the demands of the foundry industry are such that the machines now being manufactured in Britain are still incapable of meeting the whole of the requirements and a limited quantity of moulding plant is still coming in from Germany and America. Foundry executives are generally asserting that they are prepared to sacrifice some of the speed of production for greater freedom from breakdown in use, and in general they are demanding that no machine is too good for the foundry due to the exacting conditions under which they work. There is also a general recognition that a moulding machine devoid of ancillary handling plant is but a half measure towards economy, but it is worth while from the angle of giving castings of greater dimensional accuracy. The firm making the Sandslinger reports excellent progress and its latest application is for ramming up cores for the cast crank and cam shaft mould assemblies.

### Sand Plant

There has been a steady increase in the supply of sand preparing plants of various types, and the era of shovel and riddle is rapidly passing. British Baths, who are making something of the order of 2,500 baths per week at their Greenford factory, have doubled their special sand-cooling plant. This contract was handled by August's. The sales of core-blowing machines are attaining considerable proportions and very important economies have been reported as a result of their installation. One of the minor revolutions which has taken place in the last decade is the rationalisation of core and mould drying plants. For the smaller type of core, the vertical type of continuous plant seems to be making great headway against its competitors. For larger jobs, the firing is carried out much more scientifically, and extraordinarily low fuel consumptions are being reported. A newcomer in this field is a portable automatic gas producer.

(*Concluded on page 25.*)

# Conditions in the Non-Ferrous Foundry Industry in 1935

By F. BIRCHALL (Managing Director) and A. CROWTHER (Chief Metallurgist), Messrs. Peglers, Limited

THE year 1935 has been one of increasing activity for the non-ferrous foundries; not only has the demand for plumbers' fittings in connection with housing been maintained at a high level, but engineering at long last shows signs of revival, with the result that many factories have in their hands orders for a considerable time ahead.

Gratifying as this state of affairs undoubtedly is, it is not without its attendant difficulties, and it is felt that not the least of these is the supply of suitable men for important executive positions.

Three main types of production are in use in the non-ferrous foundry of to-day:—

*Class* 1.—By the skilled artisan who may be called upon to make castings of any or every kind.

*Class* 2.—By the repetition moulder, usually working on odd-sides, and generally making continuously small castings of similar, if not identical, character.

*Class* 3.—By the unskilled machine moulder.

Although in a modern foundry all three methods may be employed, the bulk of present-day non-ferrous production is gradually finding its way to the last class. In this case such things as pressure of ramming, nature and temper of sand, gating, manufacture of cores, composition and temperature of metal are all taken out of the moulders' hands and devolve upon the technical authority of the foundry.

### Competition from Drop Forgings

It should be noted, however, that many of the simpler articles which used to be cast on mass-production lines have been taken over by the hot-pressing shop, leaving the foundry for the most part hollow castings with wall thickness often not exceeding $\frac{1}{8}$ in., nearly always to be subjected to pressure test—much more difficult to meet than ordinary yield and elongation specifications—and in many cases to be chromium plated, when the polished surface must be speckless. To do all this at present-day low prices constitutes a problem calculated to baffle even the stoutest-hearted amongst modern Tubal Cains. The moulding machines and boxes must be maintained in perfect condition mechanically, absolute accuracy being essential.

In addition to the foregoing, the economical production per working day of, say, 20 or 30 tons of molten metal of the correct composition and temperature for the work in hand, constitutes a metallurgical problem of quite generous proportions.

### Dearth of Executives

The technical superintendent should, therefore, be a combination of skilled moulder, engineer and metallurgist, and it must certainly be regarded as extremely doubtful whether these men are being produced. The industry, speaking generally, of course, has not attracted the type of young man equipped to exercise these very varied functions; the conditions under which such work is generally done are not too favourable; the remuneration and prospects not too attractive.

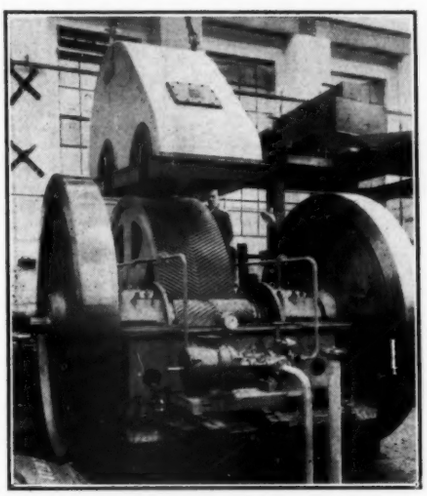
Until recently the Universities and other teaching centres have not catered for the somewhat varied and peculiar needs of the foundryman, but the past year has seen the beginning of movements which may well mark a new epoch in foundry history.

In addition to Sheffield University and the Foundry School at Birmingham, technical colleges in various other centres have instituted courses specially designed for foundry workers, and it is to be hoped that these enterprises will meet with whole-hearted support from the industry (employers and employees alike) in order that in addition to supplying technical training, research work may be undertaken.

### Nostrums and Research

It has been pointed out so frequently that the foundry industry is behind the times, relying rather upon nostrums and its more or less useful traditions, rather than upon scientifically-ascertained fact, that it is perhaps in danger of forgetting that such statements, though trite, are, nevertheless, to a great extent, true. Whilst it is correct to say that of late years some useful research work into the science of foundry technique as distinct from metallurgy has been done, it must be admitted that the ferrous side has been more to the fore in this respect than non-ferrous.

It must not be thought, however, that no pioneer work is being done; in reviewing the contributions to the various societies, one notices



A HEAVY SINGLE-REDUCTION GEAR UNIT (63.5-IN. CENTRES) FOR TRANSMITTING A NORMAL LOAD OF 1,500 H.P. OF A PEAK LOAD OF 8,000 H.P. IT WAS SUPPLIED TO ARTHUR LEE & SONS, LIMITED, OF SHEFFIELD, BY DAVID BROWN (HUDDERSFIELD), LIMITED.

with pleasure that in what might be called the "fundamental" section the work* of N. P. Allen on the Influence of Gases on the Soundness of Copper Ingots, is being extended by a number of investigators. Of necessity, some considerable time must elapse before the full effect of work of this kind is felt in the foundry itself, but there is no doubt that research along this line will ultimately bear fruit in abundance in the direction of improvement in the products of the non-ferrous foundry.

With respect to more *ad hoc* work, much of this has been submitted by workers interested in the production of light castings in aluminium alloys. The automobile and aeroplane engineers are making greater and greater demands in the direction of strength for weight, and considerable efforts are being made to cope with the situation. Furthermore, some attention has been devoted to the possibility of utilising artificially-bonded sand, with the idea that such a product would prove more amenable to control than the natural material.

Taking a broad view, therefore, one can say that the year which has just closed has witnessed a more determined attack on the mass of varied and complicated problems which worry the foundryman. It is, nevertheless, very welcome news that the British Non-Ferrous Metals Research Association has, during the year, commenced work in this direction. Preliminary surveys have revealed how extensive is the field and how great the work involved. It is very desirable, therefore, that greater interest in the Non-Ferrous Research Association should be aroused among those engaged in brassfoundry work than has been the case up to the present.

### Price of Copper

Turning, in conclusion, to a less technical aspect, we notice that during the year the price of copper has shown signs of emerging from the cloud under which it has lain so long. Few brassfounders will regret this; during the last few years the disposal of their furnace ashes, in the case of foundries using coke-fired furnaces, must have been somewhat of a problem. Having a potential value if and when copper appreciates, they could not very well be thrown completely away, and yet this value at the copper prices ruling has not been enough to pay carriage to the nearest refinery. Though too early yet to predict with any degree of certainty, there are signs that some at least of these accumulated low-grade residues are beginning to move.

Somewhat similar remarks may be made about scrap metals. It has been freely stated that there are in existence in this country large hoards of such metal, and that higher prices for copper will bring them into the market in quantity, thus maintaining a fairly wide margin between scrap and new metals. While this is undoubtedly true to some extent, the authors believe that a very exaggerated idea exists of the size of such accumulations.

In any event, with the increased facilities for melting and purifying scrap metal afforded by the now more prevalent open-flame furnaces, quite considerable quantities can be absorbed nowadays with ease and rapidity.

* "Journal of the Institute of Metals," Vol. 1, 1930.

## Foundry Equipment in 1935

(*Concluded from page* 24.)

### Melting Plant

The balanced blast cupola is well maintaining its popularity as a means of providing liquid iron for large-scale production. In the sphere of special furnaces, it is interesting to note the progress made by the rotary furnaces. Both the oil-fired and pulverised-fuel type has now invaded the field of steel production, and several installations for this purpose have been put into operation in this country. It is also worth recording that improvements have been made in both oil- and coke-fired crucible furnaces, notably the new Morgan oil furnace and the Cumming portable coke-fired furnace.

### The Future

The foundry trade in Great Britain has had to rely to a large extent in the past on foreign makers of plant. This state of affairs no longer exists as there are to-day a number of experienced and up-to-date makers of foundry equipment in this country capable of designing every type of plant.

I believe that the equipment industry can look forward to a prosperous time during 1936, and granting a continuance of the progress and alertness displayed during the past few years, has within its power the possibility of leading the world in design and manufacture of plant and equipment for the foundry trade.

# The Steel-Foundry Industry in 1935

By IAN S. OSBORN (Samuel Osborn & Company, Limited, Sheffield)

THE most cheering feature about the steel-foundry industry in 1935, as readers of the journal must be thankfully aware, has been the very much improved state of prosperity and employment over previous years. Phenomena which always accompany a period of such expansion are most evident in the form of increasing costs of pig-iron, scrap, and other steelfounders' raw materials, whilst recently wages were increased. To the author, as one outside any negotiations connected therewith, it appeared that they were conducted with a remarkable ease and smoothness. This is particularly so when compared with some of the difficulties encountered in former times.

*Production of Steel Castings in the United Kingdom for the Last Eight Years.*

| Year. | Tons. |
|---|---|
| 1928 | 162,600 |
| 1929 | 166,900 |
| 1930 | 177,300 |
| 1931 | 128,700 |
| 1932 | 115,000 |
| 1933 | 127,300 |
| 1934 | 185,700 |
| 1935 (estimated) | 194,000 |

## Melting Plant

The most widely used form of steelmaking plant for general purposes must still be the Bessemer converter or some modification. It produces a good hot steel, and at intervals of half an hour or so during the day the founder has a supply of two or three tons of molten steel, according to the size of the plant, ready to put into his moulds. For a founder doing general jobbing work, making castings from a few hundredweights up to a ton and a-half, this is ideal. For larger work he must "double" up or "treble" up, and for very big castings the only satisfactory plant is the open-hearth furnace. The latter process is, however, far less convenient for castings of, say, one ton and less. The founder finds himself, after tapping, with a big quantity of steel to dispose of, and must have a large area of floor with moulds all closed ready for pouring, or moulds for very heavy castings.

Other steelmaking processes of which the use has extended, particularly in foundries making alloy steels, are the various types of electric furnace. The most popular is the Héroult type of three-phase arc furnace. Since its introduction to the industry this has changed very little indeed, the major alterations being the use of higher voltages and automatic control of the feed of the electrodes.

*Monthly Production of Steel Castings in the United Kingdom during 1935.*

| Month. | 1935. Tons. |
|---|---|
| January | 15,500 |
| February | 15,400 |
| March | 16,500 |
| April | 15,700 |
| May | 17,000 |
| June | 14,700 |
| July | 16,000 |
| August | 15,100 |
| September | 16,900 |
| October | 18,100 |
| November | 17,100 |
| December (estimated) | 16,000 |

The most recently adopted process in the foundry is the high-frequency furnace. It is an invaluable unit for the founder who is making many different alloy steels. He can make small quantities of special steels, and can utilise to the maximum advantage his alloy-steel scrap. Indeed, one of the secrets of successful operation of such a unit lies in having a large number of bins for different qualities of scrap, and knowing accurately what every parcel of alloy scrap is. Further, there is no carbon or graphite electrode, and therefore no carbon pick-up in the charge. From an electrical point of view the high-frequency furnace is the most efficient unit, generating, as it does, eddy currents in the charge itself, and it is most important that the charge should in the first place be as dense and closely packed as possible. It has another advantage in the small thickness of refractory lining which has to be heated up in the first melt from a cold furnace; and, where the uneconomical practice of intermittent melting must be followed, it is the least uneconomical. The great disadvantage of the process lies in its relatively high capital cost, and in the fact that the installation can be justified only if there is a prospect of its working full time and producing material which will command an adequate selling price.

## Refractories

Among the most important of materials to a foundryman are his refractories, both for lining furnaces and for moulds. During the past year there has been introduced to this country a material known as Chamotte, which is used in steelmoulders' composition in the place of old clay crucible pots. Once there was a liberal supply of these pots, but with the introduction of other methods of steelmaking the supply has become inadequate. This material is produced only by firing a certain type of highly refractory aluminous clay for a prolonged period of high temperature. Advanced vitrification takes place, resulting in an impermeable mass, which is subsequently broken down and incorporated in steel moulders' composition. For many years now this process has been utilised for steel moulding on the Continent with considerable success. In this country it has been applied recently for very heavy steel castings. The resulting finish and reduction in fettling costs has fully justified expectations.

MR. IAN S. OSBORN.

A most interesting innovation in connection with moulding is the Randupson process, a French invention, which is now being investigated by founders in this country. In essence, it consists of the use of a mixture of a suitable silica sand and Portland cement, and a carefully controlled amount of water. The half mould is made generally from a half pattern on a plate and a wooden box on the same plate forms the outside of the block forming the half mould. As practised at Ugine, where the process was first adopted, semi-skilled labour is used in the moulding and comparatively little attention is paid to the hardness of ramming, as in this process this is unimportant, and no moulding boxes are used at all. It has already been fully described in this Journal.* The process does not offer any obvious advantage over green-sand moulding, but in the case of dry-sand moulds it obviates the cost of fuel for drying, as the moulds air-dry in the atmosphere. On the other hand, it demands a considerable space for the storage of the moulds during the period of 24 hrs. or more whilst they are air-drying. At Ugine a most ingenious method of stacking the moulds while drying has been evolved.

*Imports of Steel Castings into the United Kingdom for the Last Eight Years.*

| Year. | Tons. |
|---|---|
| 1928 | 12,900 |
| 1929 | 14,200 |
| 1930 | 12,400 |
| 1931 | 6,500 |
| 1932 | 1,600 |
| 1933 | 500 |
| 1934 | 1,500 |
| 1935 (estimated) | 1,300 |

## Competition from Weldings

Steelfounders have in the last year or two certainly lost business to the fabricator. The art of welding has progressed to such a degree that many steel parts required by the engineer which could formerly be made only as castings can now be made more cheaply, and it must be admitted, in many cases better, fabricated from bars and plates by welding. One class of castings which has in recent years given place to a great extent to fabricated work is yokes and other parts for motors and electrical machines, and there are others.

Upon the other hand, the making of castings in alloy steels of high strength and quality has enabled the founder to produce parts which were formerly accepted only as forgings, and at a very much less cost. There is a whole range of steels now being made for castings, containing up to 1 per cent. of chromium and from 1½ to 3½ per cent. nickel, and sometimes a small addition of molybdenum. The founder often gives his particular brand a name indicating its great ability to resist shock or fatigue or wear. To get the value from such parts it is necessary that they should be correctly heat-treated, and this means that the founder must have furnaces which can be controlled within close limits of temperature. The problem of heat-treatment has been much simplified by the comparatively cheap supply of gas which is now available, at any rate in the Sheffield district. This gas comes from the coke ovens in the neighbourhood and provides a most convenient, easily controllable, and comparatively cheap form of fuel for this particular purpose.

*Exports of Steel Castings into the United Kingdom for the Last Eight Years.*

| Year. | Tons. |
|---|---|
| 1928 | 800 |
| 1929 | 1,500 |
| 1930 | 2,100 |
| 1931 | 1,100 |
| 1932 | 700 |
| 1933 | 1,000 |
| 1934 | 2,500 |
| 1935 (not yet available) | — |

Engineers' requirements to-day call for improved qualities, not only in the supply of alloy

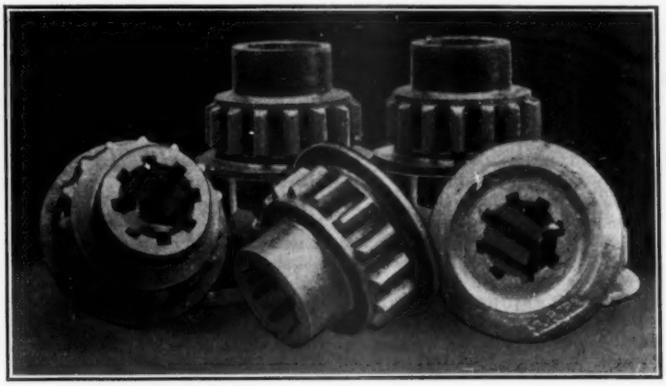
* FOUNDRY TRADE JOURNAL, September 8, 1932, page 138.

castings, but also in connection with carbon-steel castings, and more complicated designs and finishes are called for. It is curious that until this year there has never been a general British Standard Specification for Steel Castings. There have been standard specifications only for castings for railways and rolling-stock material, and for marine purposes. The essentials of the new Specification (No. 592) are as follow:—

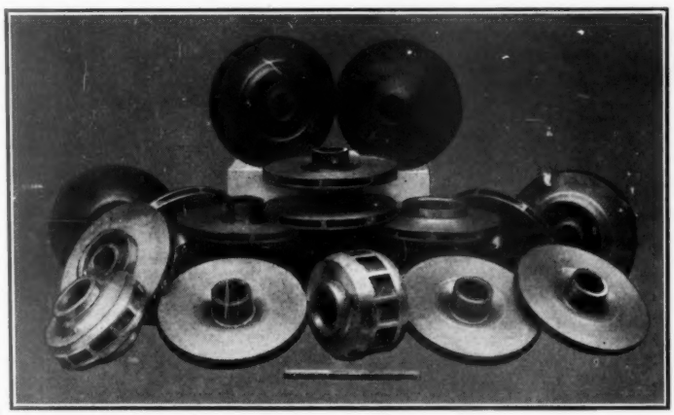
| Grade. | Minimum tensile. Tons per sq. in. | Y.P. Tons. | Minimum elongation. Per cent. | Bend. Deg. |
|---|---|---|---|---|
| 35 tons .. | 35 | 17.5 | 15 | 60 |
| 28 tons .. | 28 | 14.0 | 20 | 120 |
| 26 tons .. | 26 | 13.0 | 20 | 90 |

The castings which conform to this are equal as regards physical properties to any castings which have complied with the old marine specification, but the new specification is more exacting than the old railway specification in that, even with the highest tensile quality (35 tons per sq. in.) the material is expected to give a bend of 60 deg. This requirement necessitates the most careful selection of raw materials and possibly special desulphurising and heat-treatment.

"EVERSHYNE" STEEL CASTINGS FOR VALVES TO DEAL WITH CORROSIVE LIQUORS. THE LARGEST WEIGHS 1½ CWTS.



NICKEL-CHROME PINION CASTINGS HEAT-TREATED TO GIVE A HARD-WEARING SURFACE AND TOUGHNESS.



A GROUP OF OSBORN'S "EVERSHYNE" STEEL IMPELLERS.

One of the most important amongst the many new types of steel made generally in recent years is the range of steels containing a high proportion of nickel and chromium. These are designed for resisting either corrosion or the destructive effects of heat in some form. Probably the most common is the austenitic stainless steel containing 18 per cent. chromium and 8 per cent. nickel. To this are often added varying amounts of tungsten, molybdenum, titanium, etc., for obtaining a greater measure of resistance to specific corrosive substances. Besides having these as bars or sheets, the engineer requires to have them as castings, and their production in this form has confronted the founder with a series of most difficult problems. One lies in the fact that these alloys freeze at a higher temperature than ordinary carbon steel, and therefore the castings must be poured hotter and demand better properties from the refractories used in the mould. Another difficulty is caused by their tendency to oxidise just about the freezing temperatures; a film of oxide tends to form on the surface of the metal, causing "cold laps," particularly on thin sections. Should these remarks catch the eye of the designers, will they please remember the difficulties that beset the founder? The designer can help by keeping his sections constant in thickness, which will avoid the tendency of castings to "draw" in the excessively thick parts. In this Journal there have previously appeared articles describing steel castings of this general type. Notwithstanding their comparatively high initial cost they are continually finding new useful applications such as valve and pump parts, parts for chemical plant, road studs, to name but a few. They are being used in increasing quantities for heat-resisting purposes, such as superheater and recuperator parts; firehole doors; grate bars; burners; perrits; case-hardening boxes, and many others.

### Sand Control

The question of sand control is one which is constantly exercising the foundryman, and it would be superfluous to attempt to add here to the excellent articles which have appeared in this Journal on the subject. The amount of control exercised by the management, as opposed to the discretion of the foreman, varies enormously in different foundries. The ultimate question all the time is that of spending perhaps a little more in preparing the sand, and much less in the fettling shop. There is one new aid which has come in recent years to the fettler, and that is the high-speed artificial grindstone. Whereas formerly the bonds used in making grindstones permitted peripheral speeds of only 5,000 ft. per min., the modern bakelite-bonded wheel enables them to be run at 9,000 ft. per min. This means that the grinding done in the fettling shop has become a quicker and cheaper job.

The last months of the past year have shown generally a big increase in what is, after all, the mainstay of the trade, the production of carbon-steel castings. The result of the General Election has given a widespread feeling of security and enabled plans to be made with assurance, so that it has been possible to enter upon the New Year with that sense of confidence in the future which the industry has not enjoyed since 1929.

## The Light Castings Industry

(*Concluded from page* 28.)

many cases ironfounders who found their trade leaving them for engineering castings turned to other sections to help them out, much to the detriment of ironfounders who had been in the section they entered for a long period. In many cases firms tackled jobs of which they had little knowledge, and they were well into the trade before they discovered how much it cost to keep up patterns and plant for their production and entered into contracts at very uneconomic prices, bringing about not only a loss to themselves, but to the industry as a whole.

### Prospects

The first half of any year is always the worst period in the light-castings industry, owing to the seasonal nature of the trade. In the past ironfounders could depend on the export trade for taking away their surplus during the first few months of the year, but they cannot now look to this direction for assistance, and the bulk of their business must be done in the home market. It is to be hoped, however, that makers will have sufficient orders in their books to carry them over the month of January, and that the improvement in trade shown since the middle of 1934 will steadily go on and give them a good start in the early part of 1936. Makers can look forward with confidence to another good year. If, however, the peak has not yet been reached, it is the writer's opinion that we are not very far short of it, so that if makers can, during the next year, maintain the present level of output, the trade as a whole will be very fortunate.

That long-looked-for boom, however, would alter the whole aspect. In personal opinion, it is in the offing, but it depends on the stabilisation of currency as to when it will appear.

# The Light Castings Industry in 1935

## By JAS. M. PRIMROSE (Managing Director, Grangemouth Iron Company)

PROGRESS is the most apt note on which to commence a résumé of the light-castings industry during the past year. Light-castings ironfounders can look back on 1935 with few regrets. While there are still many black spots in the industry, trade as a whole has shown a decided improvement over 1934; in fact, the depression which commenced in 1929 has now largely been wiped out, and in some sections of the industry the figures for that year have been exceeded.

Whilst light castings cover a multitude of different sections, there are several which are outstanding, and to get a clear view of the trade as a whole one must deal with each of the different sections separately, as while some of them are linked together, others bear no comparison so far as good or bad trade is concerned. It is proposed, therefore, to deal with each section separately.

### Baths

The year just passed is probably the best from the point of view of demand that baths have experienced, but unfortunately, through lack of full organisation within the industry, the price position has borne no relation to demand. Stress of competition forced prices down to an uneconomic level, but there are indications now that the makers have seen the folly of unrestricted competition and that the reorganisation of the bath section is practically complete.

In 1934 an attempt was made to reorganise the export trade in baths and international agreements were come to with other countries. These agreements, it is understood, are now working smoothly and well, and joint marketing arrangements for Near Eastern markets have been set up in conjunction with merchants in that area. Arrangements are being pushed ahead for extending these international arrangements in collaboration with European bath makers.

*Exports of Cast Pipes and Fittings from the United Kingdom for the last Ten Years.*

| Year. | Tons. | £ |
|---|---|---|
| 1926 .. .. | 86,984 | 1,148,758 |
| 1927 .. .. | 122,823 | 1,495,251 |
| 1928 .. .. | 114,189 | 1,321,662 |
| 1929 .. .. | 136,107 | 1,455,202 |
| 1930 .. .. | 116,305 | 1,294,041 |
| 1931 .. .. | 72,776 | 804,930 |
| 1932 .. .. | 65,635 | 671,439 |
| 1933 .. .. | 86,327 | 834,153 |
| 1934 .. .. | 98,256 | 967,773 |
| 1935* .. .. | 93,897 | 940,801 |

* Estimated on the basis of the figures for the eleven months ended November.

Standardisation has been the order of the day and there are now four International Bath Association standard baths on the market, catering for every ordinary demand. The prospects of the bath section of light castings hold out high hopes for 1936, and the slogan of the International Bath Association—"A bath in every home"—is one of the best that any trade could adopt, and, apart from business, altogether it is an object which all true citizens would like to see fulfilled. A few years ago the only colour of bath that could be had was white, but recently great strides have been made in complete bathroom suites in which the bath enters into the colour scheme, and bath makers are catering for this demand enthusiastically.

### Rain Water and Soil Pipes

Makers have had a very good year with every prospect of this section of the trade continuing for some time. In fact, it is felt by some that so far as the home trade is concerned new records have been made. Until the beginning of this year very little change was made in this large section of the trade, but in the early part of the year two things arrived which shook the trade right to its foundations. The first was the inauguration of a new British Standard for cast-iron soil pipes, and the second was the advent of the patent B.I.A. "Melt-on" ear. During the whole year patternshops all over the country have been busy altering patterns to suit the new requirements with every hope that in each case the alteration is for the good of the trade as a whole.

In the case of the new soil pipe, the British Standard design will assist users, and immediately ironfounders have been able to overtake all the work in connection with its introduction the writer feels certain that makers will not then sit back and that new standards for gutters and rain-water pipes will gradually come into being.

MR. J. M. PRIMROSE.

It is, however, a very big job, and will take years to accomplish.

The advantage of the "Melt-on" ear is that it allows users to do away with the old-fashioned bobbin used to project the pipe from the wall, the projection being embodied in the ear without extra cost. This ear is gradually coming to be understood in the trade, and makers anticipate a steadily increased demand. During 1935 a joint advertising campaign to popularise the "Melt-on" ear has been in progress, and the arrangements have been made to carry out an increased campaign during 1936.

### Fitted Goods

Owing to competition, this has been far from a lucrative section of light castings for the last few years. The trade has completely changed since the war, and practically all the old patterns and designs have had to be scrapped. Makers have shown a considerable amount of enterprise in meeting the new demand, but the competition among the foundries has failed to give the makers any return for their work. During this year, while trade in practically every foundry has been brisk, prices have steadily dropped, until towards the end of this year makers found themselves in the position of making a loss, except in a few specialities. An attempt to organise the fitted-goods trade looks just now to be on the verge of success, but even although this organisation comes into being in the early part of this year, there is little hope of a recovery in prices until well on into 1936, and it will be a very considerable time before a really economic price can be obtained for the castings included in this section. It is quite easy to run down hill, as fitted-goods makers have found out to their cost, but the climbing process is long and arduous, and if any fall out by the way it will bring the whole industry back to the bottom of the hill again with a run.

### Gas Cookers and Heaters

This trade is in the hands of a few foundries, and all have shown excellent trade during 1935. The gas cooker of 1935 bears no comparison to the stove of even five years ago, and makers must be complimented on the enterprise they have shown to meet the demand of economy and efficiency.

### Electric Cookers

This is a steadily-increasing trade, but owing to cheap coal in this country the same progress has not been made as in countries where coal is more costly. Makers, however, report that 1935 has shown steady progress.

### Vitreous Enamelling

During the last five years, ironfounders have been faced with a demand for stoves that would only require a minimum labour in cleaning.

*Exports of Builders' Castings from the United Kingdom for the last Ten Years.*

| Year. | Tons. | £ |
|---|---|---|
| 1926 .. .. | 19,668 | 882,118 |
| 1927 .. .. | 17,929 | 829,644 |
| 1928 .. .. | 19,682 | 876,745 |
| 1929 .. .. | 20,522 | 928,274 |
| 1930 .. .. | 17,852 | 796,865 |
| 1931 .. .. | 13,972 | 620,457 |
| 1932 .. .. | 10,536 | 442,894 |
| 1933 .. .. | 12,968 | 537,014 |
| 1934 .. .. | 11,960 | 529,579 |
| 1935* .. .. | 12,203 | 554,284 |

* Estimated on the basis of the figures for the eleven months ended November.

This demand brought vitreous enamelling to the forefront, and now practically every foundry making fitted goods is supplying large quantities of its products in this finish. As a result the old Berlin black method of finishing is slowly disappearing.

For a long number of years makers in America and on the Continent have supplied their stoves enamelled, but it is only comparatively recently in this country that the demand for such finishes has arisen. Ironfounders are to be commended on the way in which they have met this demand.

### Engineering and Electrical Castings

Owing to the depression all over the country, this section of the trade is going to pieces, and it was impossible for any maker to get anything like an economic price for the work they were doing. A steady improvement in trade began to make itself felt at the beginning of last year, and this improvement has steadily increased. While it has still a long way to go, makers who were compelled, either through lack of work or for economical reasons, to give up this section of the trade, are beginning again to look to it as the main source of their business. This is all to the good, as in

(*Concluded on page 27.*)

# Recent Developments in the Light Alloy Foundry Trade

## By R. B. DEELEY, A.R.S.M., B.Sc.

THE past year has not been characterised by any outstanding development with regard to processes or plant, nor by the invention of any new alloy. The general increase in trade throughout the country has, of course, been reflected in the increased volume of business in the light alloy foundry trade, although this latter is in some measure due to the increased air force programmes. The increase in sales value is not strictly in direct proportion to the increase in tonnage since the better knowledge of the properties of light alloys generally together with greater experience of their behaviour in service, is enabling users very considerably to reduce sectional thicknesses. This again is further enhanced by the greater application of the stronger heat-treated alloys.

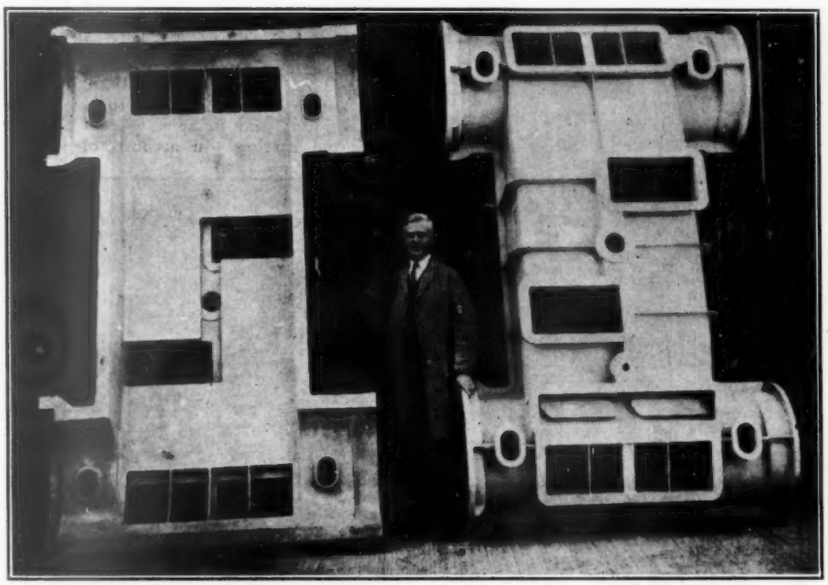


FIG. 1.—ALPAX COVERS FOR REDUCTION GEAR CASES OF THE MAIN PROPULSION TURBINES OF A BRITISH DESTROYER. (EACH CASTING MEASURES 9 FT. 5 IN. BY 5 FT. 9 IN. AND WEIGHS 594 LBS.)

The general increase in trade suggests that the depression is gradually lifting and with the prospect of a gradual return to normal conditions most founders are considering the capability of their plant to cope with anticipated further increase in business, the volume of which is naturally expected to exceed considerably that obtaining before the depression on account of the more extended applications of light alloys, and the stronger alloys now available. In this connection careful investigation of the efficiency of plant and equipment is being carried out with a view to effecting improvements which will reduce costs and/or increase the plant capacity. At least one completely new foundry has been built during the past year in anticipation of future increased business.

The market prices for pure aluminium and virgin alloys have been stationary during the year, while secondary alloys, although stationary, have recently shown a natural tendency to harden.

### Technical Developments

During the period under review there have been no outstanding developments in the pure foundry sphere with regard to the melting and casting of the alloys, although the anticipated greater demand for heat-treated alloys has caused the installation of more furnaces suited for the heat treatment. Due to the exact temperature control and uniformity of temperature required, the furnaces are generally electric.

From the viewpoint of the production of castings free from hidden internal defects, it seems probable that the use of X-ray plants, by founders who produce the highest quality castings, may become a practical and not too costly possibility in the not very remote future. At least one portable plant has recently been placed on the market which the makers claim can be used for the visual examination of 2 to 3 in. and the photographic examination of 3 to 4 in. of aluminium, while it appears that small articles can be examined by placing them on a moving belt passing between the tube and the fluorescent screen. The value of such a plant to the foundryman is not altogether clear since, although it would reveal unknown dross inclusions, the up-to-date foundry usually obtains from its test pieces, or by fractures of runners, an index to the gas content of the castings it is producing, while shrinks and draws should, so far as is possible, be eliminated by sectioning test castings prior to routine production. Internal shrinkages which cannot be overcome by chilling or feeding are usually the result of a design in which the founder has had no co-operation and it is difficult to see how X-ray inspection could aid their examination.

Hydrogen—the *bête noire* of the aluminium foundry industry—continues to receive the closest attention, and although recent publications suggest that existing knowledge of its affinity to molten aluminium is increasing metallurgists are not yet in a position economically to exclude it completely from all castings. In the case of virgin metal and alloys there is usually still a small and variable gas content while secondary alloys are generally higher and more variable. The problem seems, therefore, divisible into two separate parts, either (1) using only virgin metal, how to prevent contamination presumably mainly by the products of combustion of the fuel, or (2) how to remove the gas from gassed metal. By suitable means the object (1) can be achieved at a price, but we are still some way from a commercially economic method of completely removing gas which is there, although various fluxes are used with varying degrees of success.

During the past year the British Non-Ferrous Metals Research Association, which has been assiduously tackling this problem for some years, has made two publications, one the Paper by Hanson and Slater, read at the March meeting of the Institute of Metals, on Solidification in Sand Moulds Under Pressure—a Paper which provoked a large discussion mainly

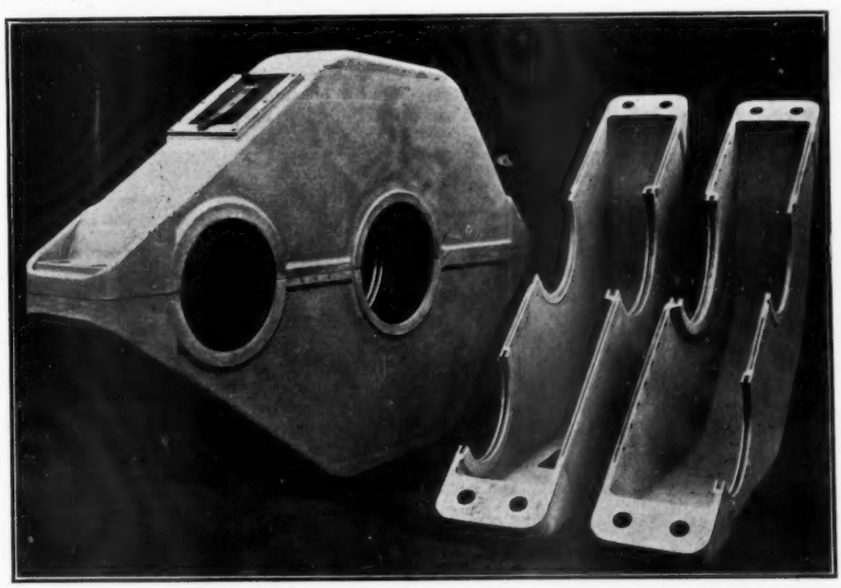


FIG. 2.—CASE FOR THE REDUCTION GEAR OF AN ELECTRIC RAILWAY TRACTION MOTOR (LIGHTALLOYS, LIMITED, CONSTRUCTION, PATENT NO. 407,432.)

around the theoretical query as to whether hydrogen is soluble in solid aluminium and which appeared generally to be considered as having no practical application—the other a patent specification (Brit. Specn. No. 435104) describing a method of stirring the molten metal under a flux while in the presence of a hydrogen free atmosphere. While this is obviously a development in the right direction it remains to be seen whether it is capable of being adapted to commercial practice on economic lines.

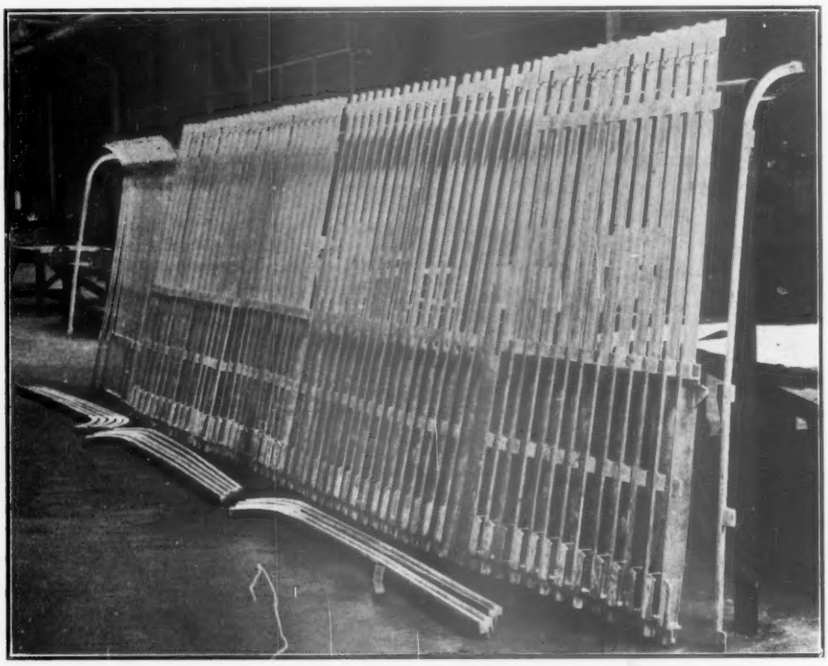


FIG. 3.—UPPER AND LOWER TRAMCAR SIDE PILLARS AS SUPPLIED TO THE EDINBURGH CORPORATION TRAMWAYS.

## Applications

The extension of applications has followed a course of normal development during the year and no particularly new application has been noted. The Aircraft industry is, of course, more intensively interested in weight reduction than other industries and the general tendency in this field is that if castings are to be used they should, if at all possible, be die castings, on account of the greater soundness. In quite a number of cases dies are now made for quite small quantities of castings, partly in view of the reduction in machining costs, but largely to ensure an article of better quality.

The transport industry generally—marine, railway, or road—is ever on the alert to discover means of obtaining economical reduction in weight, and of recent years a number of interesting new applications of light alloys have been made in the marine field. Aluminium alloy castings have not found great scope of application in passenger and freight ships, except for miscellaneous fittings such as windows, since the advantages of reduction in weight are not altogether commensurate with the increased cost. The Navy, however, has adopted these alloys more extensively, particularly in the case of engine room parts, and Fig. 1 illustrates an especially interesting application. In the railway sphere, aluminium alloy castings are employed for, doors, interior fittings and other items, and generally these are preferred in "Alpax" on account of its corrosion resistance, although its excellent foundry characteristics play an important part in the design of parts intended as substitutes for former wood or steel constructions—an interesting application is shown in Fig. 2.

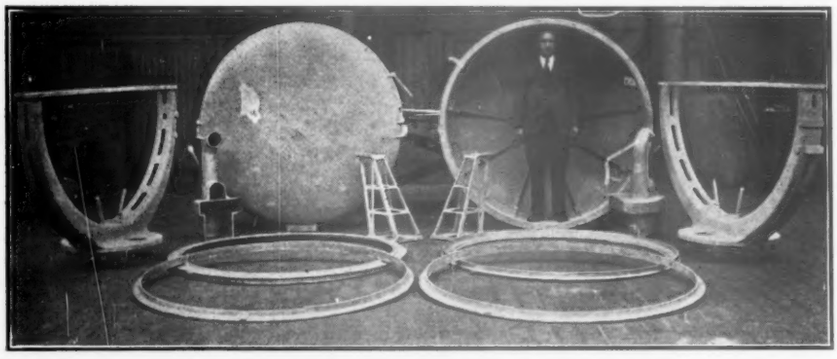


FIG. 4.—ALPAX CASTINGS FOR SPERRY 60-IN. ANTI-AIRCRAFT SEARCHLIGHT PROJECTOR.

The framework of the upper deck of a large number of the L.C.C. trams were several years ago reconstructed, using cast Alpax quarter frames; the pillars shown in Fig. 3 demonstrate how the newer heat-treated alloys are being used to reduce the weight of public service vehicles.

For high speed reciprocating parts the increasing knowledge of and experience with heat-treated alloys has led to their use in place of the heavier metals formerly used for levers, pulleys, forks, and other parts for textile plant and filling and wrapping machinery. The reduction of inertia has enabled considerable increases in speed to be attained.

In many applications it is purely the physical characteristics rather than the mechanical properties which have led designers to substitute aluminium alloys for the materials formerly used. Ease of casting and corrosion resistance of suitable alloys have both played their part in enhancing the attraction of the low specific gravity.

Many parts, if fabricated from steel sheet, would have to be heavier than required by the intrinsic loading in order to have the necessary rigidity, and in such cases very often an aluminium casting (on account of the ease of casting) can economically form the part, providing the strength and rigidity required, showing a slight reduction in weight and, as is often an added attraction, freedom from rusting. In other cases the thermal properties are attractive; the higher conductivity than iron, steel, and brass is of advantage in cases where efficient heat transference is required, and when the heating is intermittent the lower specific heat per unit volume is a definite advantage.

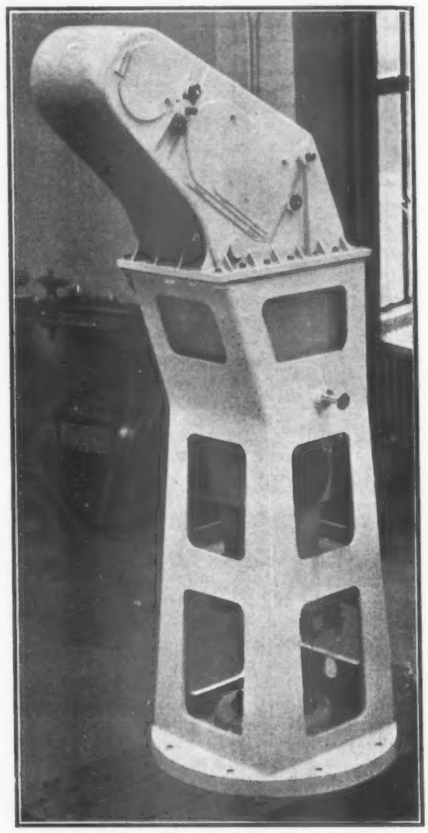


FIG. 5.—STELLAR SPECTROGRAPH FOR DAVID DUNLOP OBSERVATORY (ADAM HILGAR, LIMITED). ALPAX MAIN FRAME.

---

THE ROSE STREET FOUNDRY & ENGINEERING COMPANY, LIMITED, Inverness, have received orders from the Austin Motor Company for the construction of two large flash-welding machines for welding the steel bodies of motor-cars This is the first occasion on which machines of this size have been manufactured in this country. Previously similar machines have been imported from the United States.

# The Malleable Iron Foundry Industry in 1935

By F. D. LEY (General Manager, Ley's Malleable Casting Company, Limited)

THE past year has fulfilled the hopes that were entertained at the end of 1934 that trade was improving and that the future could be looked forward to with optimism.

During 1935 there has been a good demand for malleable castings, with the result that at the present time most foundries are very busy, and it is an excellent sign for the future that this demand has not sprung from one specific industry, but all the chief trades, with one notable exception, have shown substantial increases. The motor industry continues to expand, and there is a steady demand for the highest-quality castings for both passenger cars and lorries. The agricultural trade appears to be gradually improving, and an increased tonnage of castings has been ordered during the past year. The electrical industry makes use of malleable castings for a large variety of parts, and their engineers are appreciating more and more the excellent electrical properties which malleable iron, particularly blackheart, possesses. The sale of bicycles has kept pace with the improvement in employment throughout the country, and this has particularly benefited the white-heart foundries.

### Railway Indifference

During the next few years the improvement in the shipbuilding industry should continue, and thus result in its returning to the position it held in the past as an important user of malleable castings.

A very welcome sign is the all-round increase in orders which are classified under the term "general engineering." There was a definite improvement during 1934, but 1935 has surpassed the most optimistic hopes, and a large variety of trades are making more and more use of malleable castings.

The only disappointment from the point of view of the malleable founder is the railway industry. A few years ago the railways took a substantial tonnage of malleable castings, but this has gradually declined, and at the present time there seems to be no sign of an increase in orders for the malleable industry. Bearing in mind the large quantity of malleable castings which are used by American and other foreign railways for a variety of parts, this is disappointing, and particularly so when it is realised that the traffic in pig-iron, coal, sand, etc., carried by the railways to and from the malleable foundries amounts to over 2,000 tons per day.

### Increasing Complexity

There is still a growing tendency for castings to be more complicated. This is sometimes due to one casting being designed where two castings were formerly used. The freedom of design given by using castings is being appreciated more and more. Designers, too, are realising the advantages of consulting with the foundryman, and it is hoped that this policy will become more widespread. A few important users make it a regular practice to ask the foundry whether it can suggest any improvement in design when quoting for a new part. If the foundryman is allowed to suggest an alteration in design which enables the casting to be made more conveniently, either by a small alteration which avoids an extra core having to be used, a slight alteration to the section to facilitate soundness, and the avoidance of awkward joint lines, the result is an increase in the speed of production and a decrease in the cost of the part to the advantage of both the buyer and the foundry.

### Replacing Forgings

Engineers are continuing to appreciate more fully the excellent properties which high class malleable castings possess, and parts which formerly were never considered as being possible in malleable iron are now being made more economically and perfectly satisfactorily in this metal, and it is up to the industry to continue to educate the designers in the widespread advantages which the material offers.

There has been in the past a feeling that stampings and forgings would, in some cases, take the place of malleable castings, but this has now changed and the present tendency is the reverse. A few years ago in the United States a number of motor-car parts, particularly hubs, were turned over to stampings, but the result has been an increase in the final cost of the

MR. F. D. LEY.

parts, and there has been a general return to malleable castings. This change-over to malleable will continue to increase now that the price of steel has gone up so much, and it is important that the malleable foundries should follow this up and impress on designers the advantages of malleable over stampings for many jobs. Castings possess a great advantage, for there can be much more freedom of design, with less metal to be removed by machining, thus reducing the cost and giving much greater rigidity and freedom from internal stresses.

An interesting development last year in foundry equipment was the extended use of the gaseous discharge lamp for foundry lighting which is found to be an improvement over the ordinary lamp owing to the superior light which is obtained at less than half the cost of the current, whilst the lamps themselves have a longer life. A very valuable stimulant to the consideration of foundry lighting has been given this year by Mr. J. W. Daniel, who read a Paper* upon the subject before the London Branch of the Institute of British Foundrymen.

### Melting Practice

Rotary furnaces are still being used, but the linings are not yet giving entire satisfaction and considerably more research is necessary in order to make the furnaces as economical as other methods of melting. They have, however, the advantages of making better and more uniform quality of metal which should enable the foundry to obtain a better price for its castings. In America research upon lining materials for rotary furnaces has led to the use of silica bricks. Such linings are claimed to be superior to monolithic and a life of 180 heats on malleable without repairs is stated to be obtained. When it is realised that the silica brick linings must be maintained hot throughout all inactive periods of the furnace, it will be seen that the Americans must be satisfied with the economies.

### Quick-Annealed Malleable

The production of quick-annealed malleable has received the attention of founders for some few years and it is now possible to draw some conclusions from the work done. Attempts at quick-annealing have been chiefly confined to the blackheart variety, and have been generally along the line of using higher annealing temperatures and faster cooling, with or without some modification in the composition. The resulting metal has not been of the quality of the standard long-anneal product, either in physical properties or in regularity. Quick-anneal malleable produced up to the present possesses less ductility and poorer machinability. In spite of this manufacturers are continuing in their endeavours to reduce the period of annealing. Alteration of composition to improve the rate of graphitisation cannot be carried far because an easily annealed malleable gives primary graphite troubles in the foundry. Success in making a quick-anneal metal equal in every way to standard malleable will probably be met by improvements in oven design whereby quicker heating and more uniform temperatures throughout are obtained. Continuous tunnel ovens satisfy some of the requirements, but the large capital outlay required and other factors prejudice founders against their use.

### Machining Tolerances

Demand for extreme accuracy in castings is growing and there is a definite increase in the number of castings which have to be subjected to a setting operation. Buyers are gradually forcing the founders to produce to finer and finer limits in order to reduce machine-shop charges, and, unfortunately, this forcing often takes place after an order has been accepted, with the result that some jobs finally show a loss. It would be helpful if foundrymen would state authoritatively what tolerances are compatible with good foundry practice so that customers' demands may be kept within reasonable limits.

During the last few months there has been a noticeable shortage of skilled moulders, especially moulders who are suitable for making loose-pattern work, and there is a danger that the position will grow worse unless steps are taken to encourage young men to learn the trade.

### Labour and Raw-Material Costs

At the present time malleable foundries are faced with the fact that in some districts wages have lately been increased, whilst everywhere raw-material costs are going up considerably. This is particularly true as regards hematite pig-iron, for which foundries are having to pay substantially higher prices.

The coal position is also difficult owing to the uncertainty of the future, and it is likely that during the next year coal and coke prices will be

* FOUNDRY TRADE JOURNAL, October 17, 1935.

increased, and at the same time there is a tendency for other raw materials to follow suit.

During the last few years prices of malleable castings have continued to fall owing to the fierce competition between foundries with the object of keeping their works going, and as a result some of them are selling their castings at uneconomic prices. To meet the unavoidable increase in raw material and wages costs it is essential that malleable founders should improve their methods of production and also keep in close touch with designers in order to cheapen the cost of manufacture.

It is also important that they should have a reliable and detailed cost department so that the cost of each job can be accurately known. A very important item to control is the cost of patterns, as it is an easy matter to put in a low price for castings and then, in order to obtain the business, agree to make the patterns free of charge, with the result that the low price may become an uneconomic one.

### The Future

Regarding the future it is essential that every known factor of cost should be taken into account when fixing the selling price of the castings. For this purpose it is necessary to prepare a complete and accurate cost statement, or, in the case of a new detail, a cost estimate which must include the increased wage and material costs, pattern costs, and any special fettling and straightening charges. The price of the castings should then be based on this statement, and if this is done by all foundries there seems to be no reason why they should not receive an economic price for their castings, having regard to the volume of business which is at present available.

The malleable-castings business is so highly competitive that those who direct the industry have a constant spur to seek new methods of production in order to reduce operating costs and improve the service given to customers. The service required to-day is greater than ever before, and the quality of the finish of the castings receives more attention. The finishing departments of a malleable foundry now occupy a more important status in the business than formerly and require highly-trained and specialised men to operate them. A realisation of these facts and a continual endeavour to progress by research, by modernisation of equipment, and by recruiting specially-trained personnel will enable the malleable industry to face the future with confidence and optimism.

# Refractories Industry in 1935

## By W. J. REES, M.Sc. (Head of the Refractories Department of Sheffield University)

METALLURGISTS, especially those concerned with iron and steel production, are calling for better and better refractories to resist the increasingly severe conditions set up by high working temperatures, active slags and greater through-puts. It is timely, therefore, to consider the progress which has been made in the endeavour to meet these demands. The past year has provided, in an increasing degree, evidence of successful collaboration between makers and users of refractories and technologists. An important result of this collaboration is that the results of many investigations of fundamental importance are being rapidly incorporated into works practice. The British Refractories Research Association continues its career of usefulness, and is co-operating very effectively with the British Iron and Steel Federation and the Institution of Gas Engineers. The British Cast Iron Research Association and the Institute of British Foundrymen are also active in the investigation of particular aspects of the selection and use of refractories.

In the refractories industry there are comparatively few large units but many small units of production, and it is the latter, in general (though there are one or two outstanding exceptions), who are slowest to realise the advantages of continuous research and especially the study of fundamentals. The user naturally benefits from the production of improved refractories, but though many large users are actively supporting research both individually and through Trade Associations, it is desirable to emphasise the advantages which would be likely to accrue from the intensified attack on the refractories problems of the iron and steel industries which would be possible if greater financial support were forthcoming.

The newer types of melting furnaces, such as the high-frequency induction furnace and the pulverised coal-fired rotary furnace, have presented lining problems of great complexity, and although great progress has been made in solving them, finality is a long way off, for, as quickly as one set of conditions is met, developments in furnace design and application present others.

The call for furnace bricks of perfect shape, true to specified dimensions, has led to rapid developments in machine pressing and controlled drying and burning. The pressing of bricks from dry and semi-dry materials has increased, and hydraulic presses are now in operation which apply pressures up to 4 or 5 tons per sq. in. One interesting result of the application of these high pressures is the manufacture of "unburned" refractories, particularly magnesite, by the consolidation of graded material which has been previously dead-burned.

### Fused Refractories

A good deal of attention is being directed to the production of fused refractories, both by casting the fused material into special moulds, and by machine-pressing the crushed and graded pre-fused material. The characteristics of these materials, especially in regard to high-temperature volume stability and slag resistance, are such as will certainly lead to their increasing application.

**Mr. Job Holland, Managing Director of Messrs. Pickford, Holland & Company, Sheffield writes :—**

*"At this time it is not unnatural that our thoughts should wander to the events of the past year, and particularly to the prospects for 1936. Many of us will look back upon the past year with a certain amount of satisfaction. Aided by freedom from serious industrial disputes, trade returns have continued to show expansion of this country's activities, resulting in a gradual increase in the number of workers now absorbed in industry, and indicating a more healthy state of affairs than has existed for some time. That this improvement has been progressive, and as yet, has shown no sign of downward trend, leads me to venture the opinion that for a time, at any rate, we may look forward with confidence to still further progress in the industry of the Country as a whole. With the assurance of a strong National Government guiding the Country on sound lines, confidence—so essential to any real industrial revival—is created. We hear on all sides of important developments which are to take place this year. Many of these developments will be of considerable benefit to the iron and steel industries, and as it is primarily upon the prosperity of these industries that the success of the Refractories Industry depends, I think we can confidently look forward to the latter participating in the continued general improvement foreshadowed for the near future."*

A development of considerable importance in the production of the many shapes and sizes of ingot casting refractories is the application of what are graphically described as "de-airing machines," in which the tempered clay prior to consolidation by pugging is shredded in a vacuum vessel. Quite a considerable amount of air may be locked up in a mass of plastic clay, and its removal improves the workability of the clays, increases their strength, tends to prevent laminations and blisters, and generally improves the quality of such clay products as runner bricks, sleeves, stoppers and nozzles.

### Continuous Firebrick Making

A special type of gas-fired tunnel kiln, which permits of the closest control of the temperature and time factors in burning, is replacing the old types of intermittent kiln in the burning of these specialised refractories. As troublesome inclusions in ingots may be due to small bits of firebrick torn from the ladle lining or the inner bricks, etc., by the stream of molten metal, the increased strength, resistance and abrasion, and to the thermal shock which is resulting from the adoption of these new methods of making and burning, is of moment to the steelmaker as well as to the firebrick maker.

### High Tridymite Silica Bricks

With silica bricks for steel-melting furnaces, the general trend is towards the use of those well-converted bricks with a high tridymite content, which the research of the last few years has made commercially practicable, but there are still a few steelmakers who prefer a softer burned brick, despite (or perhaps because of) its permanent expansion in service. There is general agreement, however, that such perfection of shape as will permit of the closest jointing is essential.

### New Insulating Bricks

The interest taken by all industrial users of fuel in the conservation of heat has led to the extensive application of insulating bricks. Most of these bricks are made from diatomaceous earth of comparatively low refractory value, but great progress has been made in the commercial production of insulating firebricks which combine the characteristics of low thermal conductivity, high refractoriness, volume stability at high temperatures with sufficient mechanical strength to permit their use for constructional purposes. The low heat-capacity of these bricks renders them especially useful for furnaces which are operated intermittently.

### Basic Refractories

In the field of basic refractories such progress has been made as to lead to their use for the roof as well as for other parts of the basic open-hearth furnace, and the trials which are being made in this direction are being followed with great interest. The idea that durable magnesite bricks can only be made from raw magnesites of the "Austrian" type is being strongly contested nowadays, and many of the recently produced bricks are rich in forsterite ($2\,MgO,\ SiO_2$) and complex spinals. Mention is made earlier of the use of fused materials, and this is especially important in regard to both pure and composite refractories of basic character. The extensive resources of dolomite in this country are of great importance to basic steelmaking, and the recent production on a commercial scale of stable

(*Concluded on page* 40.)

# Foundry Mechanisation

## By GEORGE E. FRANCE (Managing Director, August's, Limited)

THE continuing competition amongst all types of founding serves to focus the attention of the founder upon *any* efficient means by which the unit cost of production of castings can be reduced, and as a consequence, the possible mechanisation of foundry processes during 1935 was given increased consideration. This movement was accelerated during the latter part of the year, and continued over the year-end unabated.

From the point some decade or so ago, when only the courageous pioneers investigated and applied mechanisation in their foundries, oftentimes to the accompaniment of the ridicule of their less enterprising competitors, such progress has been made in the design, application and operation of mechanised plant as to prove conclusively that the mechanisation of foundry processes properly applied, in properly-designed plant, and operated with intelligence, must seriously be considered by every foundry executive if the maximum efficiency and lowest unit cost is to be obtained in his foundry.

The production of castings is now being accorded as much serious attention as is the production of machine parts, and as much care is now being given to the selection of proper foundry equipment as is now commonplace to give to the selection of machine tools.

It is noticed with pleasure nowadays that on many occasion the financial and commercial executives of large concerns are encouraging the technical executives of the foundry to consider every possible application of mechanisation from the purely efficient and economic aspect. This is a considerable improvement on the state of affairs which existed some 10 or 12 years ago, when the foundry executive anxious to improve and obtain greater efficiency more often than not met with a chilly scepticism from his higher executives in his endeavours to apply the principles of mechanisation to his foundry processes.

### Influence of Improved Conditions

Doubtless the improved prosperity of the country during 1935 has had some considerable influence on this recent modification of attitude. During the depression, or at any rate during the worst stages of the depression, money was not available for investment in mechanised plant, and there are many cases where mechanisation is to-day proceeding in foundries which have long been convinced of the advantages of mechanisation and have merely delayed the application until the advent of more prosperous times. Whilst this fact is recognised, it must be pointed out that it is often a fallacy to withhold the application of mechanisation merely because of the capital involved. If mechanisation can be applied efficiently, the return of the capital involved should be accomplished within a comparatively short space of time, and there exist ways and means by which even those foundries without large capital or reserve resources can proceed at once to obtain the benefits which mechanisation can confer rather than that they should delay such improvement until they themselves have obtained the necessary capital. There exists to-day within the country's financial structure organisations solely concerned with the provision of such assistance as will enable manufacturers to obtain new plant or the introduction of modern methods which will render the manufacture more efficient.

### The Scope of Mechanisation

Another restraining influence which has often been at work is the fear either that mechanisation can only be applied where a definite demand for the product exists, or, alternatively, that the application of mechanisation must be deferred until trade so improves as to ensure to the founder a much greater demand for his output. Neither of these arguments is sound; in fact, both of them imply that mechanisation means the *complete* mechanisation of the foundry process as envisaged, for example, in the continuous-casting system, whereas, in actual fact, usually it is found that, whilst the continuous-casting system in its entirety can only be satisfactorily applied by a limited number of foundries with special conditions, yet the mechanisation of many of the processes involved in the foundry can be undertaken satisfactorily and economically by almost any foundry, irrespective of output, with the resultant advantages of a definitely lower production cost. An output reduced, for any reason, below the normal capacity of the foundry, should be an incentive to the foundry executive to explore every possible means of reducing unit cost in order, by legitimately lower prices, to secure a larger share of business with the resultant increase in the output of the foundry.

It cannot be too clearly stated that foundry mechanisation does not necessarily imply the complete mechanising of every process in the foundry nor the adoption of a complete continuous casting system. Considerable misunderstanding has arisen, and still exists, in using the term "foundry mechanisation" only as synonymous with continuous casting. Foundry mechanisation is the term applied to the mechanisation of any or all of the manual processes in the foundry, and the application of mechanisation should be considered solely on the merits of each particular process of the foundry.

### Continuous Casting

The continuous casting system represents, of course, the ultimate in foundry mechanisation but, for a variety of reasons, such as type and variety of castings, regularity and intensity of demand of castings, site conditions, labour conditions, etc., the complete continuous casting system is the exception rather than the rule, and must remain so, but that does not mean to say that because any particular foundry cannot justify the installation of a complete continuous casting system that none of the processes in that particular foundry cannot be efficiently and economically mechanised. It may not, for instance, be an economic proposition to instal a continuous casting system in a foundry, but it may pay handsomely to instal mechanical charging for the melting equipment, and/or a central sand handling system, or to instal conveyors for the more efficient transportation of ores. It follows, therefore, that in the whole range of foundries in this country, from those certain foundries in the automobile trade, or the gas or electric trade where continuous and regular heavy demand of castings exists and where the type and variety of castings is comparatively restricted, well known and under control, to the foundries at the other end of the scale which are prepared to tackle any type of job, from a few ounces to several tons, be it any of the range of cast iron alloys, there must exist a similar disparity in the possible mechanisation of such foundries. When all is said and done mechanisation merely implies the performance of manual operation by machinery and the examples where some mechanisation in some form or other cannot be satisfactorily applied in the modern foundry are indeed few.

For example, in the case of a jobbing foundry taking on any type of work which is offered to it, whilst such a foundry may be dealing in an enormous variety, weight, shape and intricacy of castings, it is dealing in lumps of of pig-iron of comparable size which might themselves, dependent upon the volume of consumption, be susceptible to some mechanisation in their handling; or it is equally dealing with possibly large volumes of sand, the transportation, preparation and general handling of which can be mechanised to the advantage of the unit cost of production of the general run of castings produced.

Whilst 1935 has seen several continuous-casting systems installed, yet the bulk of the work has been mechanisation of individual processes and very many foundries have installed, and are installing, mechanical means for cupola charging, sand preparation and handling for moulds and cores, and simple means of mould and core handling where power-operated conveyors could not be justified. The advent of more efficient moulding machines, and the continued development of core-making and blowing machines have rendered more desirable than ever mechanical handling of sand to, and cores and moulds away from, these machines; whilst the development during the year of more efficient sand-cleaning equipment has involved the introduction of mechanical methods in the handling of castings to the cleaning room.

### Foundry Sands

Foundry sand has received during the last year a considerable amount of attention, both in the technical Press and amongst the meetings of the foundrymen themselves, and is, indeed, the subject of considerable controversy and investigation at the present time. This focusing of attention upon foundry sand is ideed extremely valuable and very desirable, and coincident with this increasing interest has arisen a greater interest in the means of preparation and handling. Many foundries, unable by various circumstances to apply mechanisation to the handling of their moulds or cores or castings, have found it very profitable mechanically to handle and automatically to prepare their core and moulding sands. Complete mechanised sand plants are now available, receiving the used foundry sand, cleaning it, cooling it, removing all foreign matter from it, storing it, and preparing it in suitable mixtures ready for delivery back to the moulding stations. These plants have now reached a high pitch of efficiency, and can definitely be regarded in the same light as machine tools.

Similarly, in the core-sand mixing department, such semi-automatic plants are now being installed which receive the raw sea sand, dry this sand, screen it from all foreign matter, cool it, and automatically deliver it into the mixing unit, whilst a further extension of these plants enables the various mixed core sands to be delivered to the core-making benches, or machines. These mechanical plants work with the minimum of labour, and render the processes almost automatic, and whilst they easily justify themselves economically, yet provide the foundry executive with a very valuable tool, in so far as they enable him easily to obtain and retain complete control of core and moulding sands and to reduce therefore the very considerable number of variables which have hitherto existed in these departments.

The considerable experience of past years is now at the disposal of designers and manufacturers of mechanised foundry plant with the result that modern foundry equipment reaches a high standard of mechanical design and workmanship. These plants are designed expressly for use under the admittedly difficult conditions of foundry work and fulfil their functions very satisfactorily.

# The Foundry Industry Month by Month

### January

MR. ROY STUBBS, immediate Past-President of the Institute of British Foundrymen, is elected Vice-President of the Manchester and District Ironfounders' Employers' Association.

AT A MEETING of the Council of the Institute of British Foundrymen, held in Bradford, Sir William Larke, K.B.E., and Mr. S. G. Smith are elected honorary members.

CAPTAIN NORMAN A. DORE is elected chairman of the Royal Metal Trades' Pension and Benevolent Society.

### February

THE RT. HON. THE EARL OF DUDLEY is elected President of the Iron and Steel Federation.

MR. ALFRED HODGSON, of Canal Foundry, Openshaw, Manchester, is appointed honorary treasurer of the National Ironfounding Employers' Federation.

THE ANNUAL DINNER AND DANCE of the Institute of Metals is held under the presidency of Dr. Harold Moore, C.B.E., with Sir Richard Redmayne, K.C.B., as the principal guest.

### March

THE BESSEMER GOLD MEDAL of the Iron and Steel Institute for 1935 is awarded to Prof. A. M. Portevin.

SIR FRANCIS JOSEPH, C.B.E., J.P., D.L., chairman of the Central Pig-iron Producers' Association, is nominated to succeed Lord Herbert Scott as President of the Federation of British Industries.

MR. G. T. LUNT is elected President of the Foundry Trades' Equipment and Supplies Association at their annual meeting. MR. A. G. TURNER is re-elected Vice-President, and MR. G. E. FRANCE is also elected to that office.

SIR THOMAS BELL, managing director of Messrs. John Brown & Company, Limited, Clydebank, retires.

H.R.H. THE PRINCE OF WALES is the principal guest at the annual dinner of the British Iron and Steel Federation at which the Rt. Hon. the Earl of Dudley presides.

THE ANNUAL DINNER of the Refractories Association is held in London, under the presidency of Mr. Alex. Lomas, deputising for his father, Mr. William Lomas, J.P., the President, who is 94 years of age. During the evening Mr. F. Metcalfe Fisher is inducted into the chair.

DR. ANDREW MCCANCE is re-elected chairman of the West of Scotland Iron and Steel Institute.

### April

SIR CHARLES CRAVEN, managing director of Messrs. Vickers-Armstrongs, Limited, accepts the Presidency of the Tyneside Industrial Board.

THE FRENCH FOUNDRY TECHNICAL ASSOCIATION at their annual meeting elect Mr. Emile Ramas to succeed Prof Girardet as President.

CONSIDERABLE INTEREST is aroused by the report that negotiations are taking place for the creation of a new merger in the light-castings industry.

MESSRS. HENRY WIGGIN & COMPANY, LIMITED, celebrate the centenary of their foundation.

### May

SIR H. C. H. CARPENTER, F.R.C.S., the new President of the Iron and Steel Institute, takes the chair at the Annual Meeting of the Iron and Steel Institute in London.

PROF.-ING. DR. MONT. FR. PISEK, Professor of the Czech Polytechnic School at Brno, is re-elected President of the Czecho-Slovak Foundry Technical Association.

THE CASTLE BROMWICH SECTION of the British Industries Fair is opened.

SIR WILLIAM BARCLAY PEAT is elected chairman of the Council of the Tin Producers' Association.

THE ANNUAL MEETING of the Staffordshire Iron and Steel Institute is held in Dudley.

PROF. W. L. BRAGG, F.R.S., delivers the twenty-fifth annual May lecture of the Institute of Metals.

THE FIRST ANNUAL MEETING of The Institute of Vitreous Enamellers is held at the British Industries Fair, Castle Bromwich. Mr. W. H. Whittle presides in the absence of the President, Dr. J. W. Mellor, F.R.S.

THE ANNUAL MEETING of the British Standards Institution is held in London, with Dr. E. F. Armstrong, F.R.S., in the chair.

### June

THE ANNUAL MEETING of the American Society of Testing Materials is held.

A SUCCESSFUL PROPAGANDA MEETING of The Institute of Vitreous Enamellers is held in Glasgow at Whitsuntide. Mr. W. H. Whittle presides over a technical session, and a visit is made to the works of Messrs. Shanks & Company, Limited, Barrhead.

SIR ROBERT HADFIELD, BT., F.R.S., attains the Diamond Jubilee of his association with the world-famous firm which bears his name.

THE ANNUAL MEETING of the Institution of Welding Engineers is held in London.

THE BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION announce the inauguration of a five-year plan of research work at their annual meeting in Birmingham.

THE ANNUAL MEETING of the German Foundrymen's Technical Association is held in Berlin under the chairmanship of Dipl.-Ing. W. Bannenberg. The authors of the principal technical Papers include Dr.-Ing. K. Roesch, Dipl.-Ing. A. H. Ludwig, Dr.-Ing. E. Knipp, Dr.-Ing. W. Baukloh, Dr.-Ing. Fr. Bischof, and Prof. Dr.-Ing. H. Uklitzsch.

### July

THE THIRTY-SECOND ANNUAL CONFERENCE of the Institute of British Foundrymen is held in Sheffield. Mr. J. E. Hurst is unanimously elected President and delivers the presidential address. Mr. H. Winterton, of the Scottish Branch, is elected Senior Vice-President, and Mr. C. W. Bigg (East Midlands) Junior Vice-President. Mr. H. Bunting is awarded a Meritorious Service Medal. Six diplomas are awarded for Paper presented to the Branches during the past session. At a Civic Reception, delegates are received by the Lord Mayor of Sheffield and the President of the Sheffield Chamber of Commerce. Sir William J. Larke, K.B.E., delivers the first Edward Williams Lecture on "Man and Metal." A very successful annual banquet is followed by entertainment and dancing at the Royal Victoria Hotel, and after a number of works visits the convention concludes with an excursion along the valley of the Derwent.

### August

THE AMERICAN FOUNDRYMEN'S ASSOCIATION awards the Penton Gold Medal to Major Lawrence Lee Anthes, of Toronto, Canada.

MR. J. G. PEARCE, director of the British Cast Iron Research Association, is elected a member of the Council of the Staffordshire Iron and Steel Institute.

### September

THE FOUNDRY TRADES' EXHIBITION opens at Olympia, in conjunction with the Shipping, Engineering and Machinery Exhibition. The exhibitors include about fifty foundries, and there are many novel and interesting exhibits. At the banquet given by the organisers (Messrs. F. W. Bridges & Sons) the principal speakers include Mr. R. H. Brackenbury and Mr. C. Monseur, of Liége.

THE ANNUAL MEETING of the Institute of Metals is held in Newcastle-upon-Tyne.

THE IRON AND STEEL INSTITUTE holds its autumn meeting in Manchester, under the presidency of Sir H. C. H. Carpenter, F.R.S. A presentation is made to Mr. G. C. Lloyd.

THE SECOND ANNUAL CONFERENCE of The Institute of Vitreous Enamellers is held in London, Dr. J. W. Mellor, F.R.S., presiding. A visit is made to the Foundry Exhibition at Olympia, and an attractive instructional and social programme includes the annual banquet, followed by a dance and cabaret; a visit to the works of Messrs. Belling & Company, Limited; and a Paper read by Mr. C. P. Stone.

THE INTERNATIONAL FOUNDRY CONGRESS is held at Brussels, under the patronage of H.M. King Leopold III. About 30 participants come from Great Britain. Mr. Léonard, the President, receives a decoration from the King. Vitreous enamellers also participate, Mr. B. B. Kent being the chaperon.

### October

THE BRITISH FOUNDRY SCHOOL at Birmingham is initiated.

THE FOUNDRY TRADE JOURNAL receives congratulations on reaching its thousandth issue on October 17.

THE ANNUAL MEETING and luncheon of the British Cast Iron Research Association are held in London, Major F. A. Freeth, O.B.E., D.Sc., F.R.S., presiding.

### November

OVER ONE HUNDRED MEMBERS registered for the second British Cast Iron Research Association Study Course held in Birmingham.

WITH GREAT REGRET the death is recorded of Mr. F. W. Finch, the founder and first secretary of the Institute of British Foundrymen.

A PRIVATE COMPANY, styled the British Iron and Steel Corporation, is formed to carry on the selling activities of the British Iron and Steel Federation.

THE EIGHTY-SEVENTH ANNIVERSARY DINNER of the Royal Metal Trades Pensions and Benevolent Society is held under the presidency of Capt. N. A. Dore, in the absence through illness of the chairman, Mr. V. Jobson.

MR. A. B. HARROWER, of the British Oxygen Company, Limited, represents the British Acetylene Association at the Annual Convention of the International Acetylene Association.

### December

THE ANNUAL DINNER of the British Ironfounders' Association takes place in London, Mr. W. R. Blair presiding. Mr. Geoffrey H. Shakespeare, Parliamentary Secretary to the Minister of Health, proposes the toast of "The British Ironfounders' Association."

THE VEREIN DEUTSCHER EISENHÜTTENLEUTE hold their annual meeting at Düsseldorf, at which the Verein celebrates the 75th anniversary of its foundation.

THE ANNUAL DINNER of the London Branch of the Institute of British Foundrymen is held under the presidency of Mr. F. O. Blackwell. Sir P. J. Hannon, M.P., is the principal guest.

THE NEW RESEARCH LABORATORY of the London Midland & Scottish Railway Company at Derby is opened by Lord Rutherford of Nelson.

MR. C. BRUCE GARDNER becomes chairman of the London Iron and Steel Exchange, in succession to the Rt. Hon. Lord Greenwood.

FEDERATED FOUNDRIES, LIMITED, is formed by the amalgamation of certain companies engaged in the light-castings industry. Mr. William Rennie is appointed chairman.

FOLLOWING NEGOTIATIONS between the joint committee of Light Metal Trades Unions and the National Light Castings Ironfounders' Federation, wages cuts made in 1928 are restored to workers in the light-metal trades.

# Recent Developments in Foundry Research

By J. G. PEARCE, M.Sc., M.I.E.E., F.Inst.P. (Director, B.C.I.R.A.)

NO one reviewing the results of foundry research during the past few years can fail to be impressed by the tendency of engineers to return to the simple casting for many of their products. The history of engineering has been so much one of superseding cast metals by wrought and of the replacement of comparatively simple by more complex materials, or materials treated in a more complex way, that founders have come almost to regard the process as inevitable. The tendency in the opposite direction is, therefore, all the more welcome, and has been brought about by the results of scientific research. For example, although at one time the testing of materials was confined to simple static tests, in more recent times tests have been made of fatigue strength, that is, the strength under repeated or periodic stress. Since this simulates the condition under which a great deal of metallurgical material is used in engineering, fatigue strength is a most important property.

The fatigue strength of cast iron is improved as the graphite is refined and increases with improvement in surface finish of the bar tested. The fatigue strength of cast iron is a very satisfactory proportion of the tensile strength, when compared with the same ratio for steel or wrought iron, being about one-half the tensile strength. In applying these figures to practice, the designer must also know how the fatigue strength is affected by the design of the part, and in Germany the term "moulded strength" or "design strength" has been coined to take into account the difference between the ideal test-bar figure and the figure obtained in practice. The point about cast iron in this connection is that it is much less susceptible to what have been termed in the States "stress raisers," that is, notches, holes, re-entrant angles and other features of design as compared with steel.

A German writer recently quoted a case of an aeroplane crankshaft for which a steel is used having a tensile strength after heat-treatment of 63 tons per sq. in. The fatigue strength in bending is 30 and in torsion 19 tons per sq. in. on the polished bar. In spite of these figures, the crankshaft breaks in operation when the calculated nominal torsion strength amounts to 4½ or 5 tons per sq. in., due to the design strength being different from the ideal test-bar strength, arising from notches, changes in thickness and operating conditions, which are different from those under which a laboratory test is taken. In cast iron, although the static properties are low and the fatigue strength good on the test-bar, the difference between the designed strength and the strength of the test-bar is much less than is the case with a steel such as is mentioned above. This is doubtless one of the reasons for the success of the cast crankshaft, referred to later. Dr. Gough and Mr. Pollard recently presented to the Institution of Mechanical Engineers a Paper[1] on the strength of metals under combined alternating stresses, and among the three materials tested was a 6 per cent. silicon iron which was chosen and supplied by the British Cast Iron Research Association as a brittle material. The remarkable fact emerged in the report that the fatigue strength of this material is as high as the static tensile strength, the endurance ratio, in fact, being unity. The endurance ratio is the ratio of the endurance limit in fatigue (the fatigue strength) to static tensile strength. The authors state that this result has never been recorded before and in the discussion the present writer suggested that the result arises from the fact not that the fatigue strength is high, but that the static strength is low, and that, in fact, cast iron, because it is notched by graphite flakes, fails at low figures in tension compared with the strength taken in fatigue. The result is that cast iron behaves under vibration or fatigue strength much better than would be expected from static tests.

### What is Cast Iron?

The question of crankshafts raises the problem of the definition of cast iron, which has recently been discussed by Dr. A. L. Norbury.[2] Various suggestions have been made from time to time, but these are descriptions rather than definitions; such, for example, as those tentatively proposed by the American Society for Testing Materials. Dr. Norbury would define white cast irons as those containing carbide eutectic, as

MR. J. G. PEARCE, M.Sc.

grey cast irons those containing graphite eutectic and as mottled cast irons those containing both. The steels then become alloys of carbon (other than malleable cast irons) which contain neither carbide eutectic nor graphite eutectic in the microstructure. It will be seen that this definition presupposes that the graphite in grey cast iron is eutectic in origin, but without entering further into this subject at present, the definition does succeed in differentiating the cast irons from the steels and presents a means of separating one from the other, which should be useful in legal and patent cases, and nothing beyond the microscope is required to settle the matter. The conception of steel as an iron-carbon alloy containing less than 1.7 per cent. carbon or thereabouts is not valid, because the presence of other elements may lower this figure materially. Thus the high-silicon or high-chromium acid-resisting irons and cast crankshafts with less than 1.7 per cent. of carbon are true cast irons.

### Cast Crankshafts

The best account to date of the Ford crankshaft is due to Mr. E. F. Cone[3] and the shaft is now a commercial success and its production is established practice. As far as the American works is concerned, it contains 1.35 per cent. to 1.6 per cent. carbon with copper, silicon and chromium. It is heat-treated. It supplanted the forged and heat-treated steel shaft of about 0.4 per cent. carbon of the usual type. Attempts were made to die-cast this material without success and it was then cast in greensand, but the shafts either were white or warped excessively. It was finally decided to use a multiple drysand mould and to make a castable material and in order to do this copper was employed and chromium was added to increase the wear. Ultimately a castable, wear-resisting, shock-resisting, but machinable material was made with carbon, 1.35 to 1.6 per cent.; silicon, 0.85 to 1.1 per cent.; manganese, 0.60 to 0.80 per cent.; copper, 1.50 to 2.00 per cent.; chromium, 0.40 to 0.50 per cent.; phosphorus, 0.10 per cent. max., and sulphur, 0.16 per cent. max.

It is held for twenty minutes at 900 deg. C. in a gas-fired furnace, air quenched to 650 deg. C., reheated for one hour to 805 deg. C., and cooled for a further hour to 538 deg. C. It is cast from the electric furnace and gives a transverse strength of about 75 tons per sq. in. and tensile strength of about 48 tons per sq. in. with an elongation of about 3 per cent. The Brinell is 269. A slightly modified composition is also being used for brake drums. It is stated that the new cast shaft weighs about 10 per cent. less than the forged shaft and requires less material to be removed and that since September, 1933, over one and a half millions of such shafts have been produced and assembled. There is no doubt, in addition, that the cast shaft has superior wearing properties and is also able to withstand the service conditions, doubtless due to the damping capacity possessed by cast iron, or its ability to absorb vibrations which may be imposed on the shaft in service instead of passing them on, possibly to build up in resonance with other vibrations to a dangerous condition.

A German Paper[4] gives the collection of references mentioned in Table 1, showing some of the types of material used for other crankshafts, employing nickel, chromium and molybdenum, from American sources.

TABLE I.

| No. | T.C. | Si. | Mn. | Ni. | Cr. | Mo. |
|---|---|---|---|---|---|---|
| | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. |
| 1 | 2.61 | 2.34 | 0.48 | 1.7 | 0.08 | 0.25 |
| 2 | 2.75–3.0 | 1.9 –2.3 | 0.55–0.75 | 1.0 –1.5 | — | 0.5–0.75 |
| 3 | 2.8 | 2.0 | — | 0.75 | 0.20 | 0.75 |
| 4 | 2.8 –3.2 | 1.8 –2.3 | 0.6 –0.8 | 1.4 –1.7 | 0.3–0.6 | 0.5–0.6 |
| 5 | 2.9 –3.1 | 1.75–2.0 | 0.5 –0.6 | 1.25–1.5 | 0.3–0.4 | 0.5–0.6 |
| 6 | 3.3 –3.4 | 1.7 –2.0 | 0.6 –0.8 | 2.0 | 0.75 | — |
| 7 | 2.25–2.5 | 1.0 –1.5 | — | 3.0 –5.0 | trace | — |

To give some idea of the magnitude of the foundry industry, Prof. H. L. Campbell[5] mentions a survey completed in the United States by "The Foundry," June, 1935, showing that there are 3,215 plants in the States producing grey iron castings, 147 producing malleable iron castings, 319 producing steel castings, and 2,574 producing non-ferrous metal castings. The estimate is given of over fifteen million tons of

iron castings produced each year. The American Iron and Steel Institute figure of nearly half a million tons of cast-iron pipe produced in 1933 is quoted, together with the estimate of the U.S. Department of Commerce for the production of malleable iron in 1931 as 312,000 tons, which is said to be only a small fraction of possible capacity of malleable iron plants in the United States. The Steel Founders' Society of America estimates the yearly capacity of steel castings as 2,300,000 net tons. The U.S. Department of Commerce figure for 1933 for the production of bronze and brass castings is nearly 33,000 tons. A tractor-type mechanical excavator has 78 per cent. of the weight of materials in it made in foundries. In another representative tractor, 53 per cent. of the total weight was made in metal castings, in about 380 separate pieces. An overhead travelling crane with a lifting capacity of 180 tons has about one-fourth of its entire weight in metal castings.

### B.C.I.R.A. Progress

During the year a new sands laboratory has been set up at the Association's headquarters, for work previously done at the University of Sheffield, complete with furnace room for testing the refractoriness of linings and patching materials. Most of the sands investigational work for some months past has centred around the use of clay additions to silica sand and to natural sand, and deals with the choice of appropriate clay additions and the most suitable proportion to add, together with the best moisture content and methods of treatment. In addition to a good deal of ordinary development work, much information has been received and collated from members using rotary furnaces and cupola furnaces, on linings and patchings to form the basis for further investigation.

The development of the balanced-blast cupola continues very satisfactorily. There are at present over one hundred of these furnaces installed or under construction, having an aggregate output exceeding 700 tons per hr. They are being used in the production of all types of iron, light and heavy castings, malleable cast iron and refined pig-iron, etc., and are to be found equally in jobbing foundries undertaking a variety of work, sometimes with very short runs, and also in large continuous production foundries having runs up to 18 hours' duration. One-half the furnaces now under construction are being supplied to members who have already put in one or more of these furnaces previously, and the furnace has been installed so far by no fewer than 20 per cent. of the members of the Association operating cupola furnaces. It is estimated that the approximate savings in fuel from these installations amount to £20,000 per annum, approximately three times as much as the Association receives from the whole industry, and if applied throughout the industry aggregate savings could easily reach a quarter of a million sterling per annum. It must be emphasised, however, that the Association does not regard fuel savings as the most important advantage gained in this way, and, even where the length of the run and throughput do not permit appreciable saving, the benefits arising from high temperature metal and freedom from oxidation more than justify the change.

In conjunction with the London Midland & Scottish Railway Company at Derby, and in the Association's own cupola, a series of metallurgical cokes have been tested to ascertain their melting quality and the complete series of laboratory tests is being made with a view to correlating practical results with laboratory tests. Some of these are being made by the Northern Coke Research Committee. An important investigation has been begun on the shrinkage and contraction of cast iron and active work is in progress on alloyed irons with special reference to the influence of copper and of molybdenum. Some interesting work on the refining of graphite is to be followed up in co-operation with the Iron and Steel Industrial Research Council of the British Iron and Steel Federation. This involves the application of graphite-refining methods to the production of ingot moulds.

Various other points of interest were given in the Association's Annual Report, published in the journal on October 31 last and do not need further reference.

There is no doubt that production of high-duty irons, both plain and alloyed, continues to make progress. At the same time, the nucleus theory on which the practice of inoculation or ladle treatment is based has been abandoned, and the work of Piwowarsky, for instance, has shown that graphite goes into solution much too quickly to justify the belief in the persistence of the graphite nucleus. The theory, however, was always recognised to have its drawbacks and has been abandoned for various reasons and the focus of metallurgical interest is shifted to the slag in the metal.

Attention should be drawn to the remarkable success of the conference on welding organised by the Iron and Steel Institute and a large number of other interested bodies. On the practical side, the extremely comprehensive Paper by Mr. Machin and Mr. Oldham presented to the conference of the Institute of British Foundrymen may be mentioned, and on the equipment side, the machine for shot-blasting by the force communicated to the shot by a centrifugal wheel is notable. Mr. H. H. Shepherd has admirably reviewed progress in malleable cast iron,[6] and mention may also be made of the Paper by Mr. Rees on foundry refractories,[7] the contributions by Mr. Shaw[8] and Mr. Harbach[9] on testing, and Dr. Swinden and Mr. Bolsolver on ingot moulds.[10]

BIBLIOGRAPHY.

1 "Strength of Metals under Combined Alternating Stresses," by Gough and Pollard, "Institution of Mechanical Engineers." Preprint, November, 1935.
2 On the Definition of the Terms "cast iron" and "steel," A. L. Norbury, D.Sc. "B.C.I.R.A. Bulletin," vol. 4, No. 5, July, 1935.
3 "The Story of the Ford Cast Crankshaft." E. F. Cone, "Metals and Alloys," September, 1935.
4 "Technische Blatter," XXV, October 13, 1935.
5 "The Metal Casting Industry." H. L. Campbell, "Metals and Alloys," August, 1935.
6 "Iron and Steel Industry," November and December, 1935.
7 FOUNDRY TRADE JOURNAL, July 18 and November 14, 1935.
8 FOUNDRY TRADE JOURNAL, November 21, 1935.
9 FOUNDRY TRADE JOURNAL, July 25, August 1, August 29, October 3, October 24, October 31, 1935.
10 FOUNDRY TRADE JOURNAL, August 1, 8 and 15, 1935.

# The Nickel Industry in 1935

## By ROBERT C. STANLEY (President, The International Nickel Company of Canada, Limited)

STATISTICS for the first ten months of 1935 indicate that last year's business will be the largest in the history of the nickel industry. Because of the increase in demand, which has been steadily maintained since the low point in 1932 and because the industry's success has been based on a policy of an assured source of supply and prompt deliveries, additions are now being made to production facilities in order to provide reserve capacity. World consumption of nickel in all forms during the first ten months amounted to 133,300,000 lbs. This compares with 112,481,600 lbs. in the first ten months of the previous peak year, 1929, and with 102,780,000 and 77,600,000 lbs. respectively in the similar periods of 1934 and 1933.

Although this further increase in consumption undoubtedly reflects a tendency among certain world powers to strengthen their metal reserves, analysis of world nickel consumption definitely shows that the great bulk of the metal continued to move directly into established peacetime uses. As a basic material, nickel has been among the first commodities to feel the impulse of returning industrial activity. Reports from all centres indicate a general restocking of bins and replacing of obsolete equipment. This is a development which logically follows a prolonged period of industrial curtailment. In this connection it is significant that nickel is now employed in one form or another by major industries, and that there are in world markets more than 1,000 trade-marked alloys containing nickel.

### New Laboratories

The current year, with its considerably higher total deliveries, continues to show approximately the same division between New World and Old World consumption as obtained in 1934, and thus is a measure of further industrial improvement. To keep up with the growing interest in the application of nickel to widely diversified industrial and engineering problems, the laboratory at Birmingham was enlarged and modernised and a new laboratory was projected at Copper Cliff, Canada. With the modern laboratory at Bayonne, New Jersey, these developments furnish the nickel industry with a broad basis, not only for independent research, but also for co-operation with the technical activities maintained by various other units of world production. In addition, the metallurgical service to industry was strengthened by staff additions in all countries where nickel enters into industrial markets.

Of wide significance is the general trend noticed in the various fields of industry to specify better grades of materials in the machinery and equipment now being ordered for replacement purposes. It would seem that business as a whole is turning from a psychology of *laisserfaire* to a policy of forward planning. This change is seen time and again in the specifications for nickel alloys in fields where simple metals had previously been customary, and for further improvement in applications already standardised on alloys. The durable goods industries, for example, toward which we looked with anticipation in 1934, have shown increased activity in 1935.

At the same time the recognition of corrosion as a serious industrial problem is definitely broadening. The ability of metallurgists to provide not only ferrous alloys with high resistance to rust and corrosion, but also non-ferrous alloys with the strength and other physical properties of steel, is making possible a new day particularly in the chemical- and food-processing industries. Better knowledge of plating, perfection of the processes for cladding steel with pure nickel, Inconel or stainless steel, and the substantial increase in the physical properties of these products, are stimulating profound changes in industrial design and are creating new potentialities for many lines of production.

The extent to which the many phases of the corrosion problem are holding the attention of industry is indicated by the fact that in the United States alone more than 2,000 field

corrosion tests are now being conducted. The data thus being accumulated will undoubtedly have an important influence on future design and specification for many types of machinery and equipment.

### Stainless Steels

The stainess steels are a substantial factor in this situation as well as contributing new concepts to transportation design. In this latter case the reduction in deadweight of rolling stock is of prime importance to the carriers. By eliminating the problem of deterioration through rust, the stainless steels can be used in thinner and lighter sections than could the materials previously standard for car construction. This reduction in mass weight makes for quicker starting and stopping of carrier units as well as for lower power consumption in haulage. It is popularly recognised in the streamline passenger trains which are now maintaining regular schedules on various railways.

The progress made by the stainless steels during recent years when most steel production was seriously curtailed inspires confidence in the future of these alloys, which now constitute the second largest outlet for nickel in Great Britain. In this future our industry has an important participating interest because of the nickel content in stainless steel.

### Alloy Steel Castings

Two other classes of alloy steels have been utilised for supplementary applications in the field of weight saving. Experiments with low alloy, corrosion-resisting steels led to the development of intermediate alloys in which nickel and copper (with or without other additions) are essential elements. The other class is that of the low-cost, nickel-manganese cast steels which found use for light-section side frames, bolsters and other car castings, and which are being adopted by manufacturers of tractors and power shovels. Both classes are more fully described in the section on transportation.

The nickel industry itself provides an example of what is being done to decrease deadweight. The skips which hoist ore 3,000 ft. at the Frood mine have been redesigned in nickel steels to give a 16 per cent. increase in load capacity. With no change in overall dimensions and with no increase in the size of the hoisting cable or of power consumption, each of these new skips has added more than 400 tons to its hoisting capacity in the eighteen hours it is operated daily.

### Nickel Cast Iron

Of equal significance from the point of view of the nickel industry is the growing interest in alloy cast irons. Well established before the industrial revolution of a century ago, common grey cast iron began to lose its pre-eminent place a generation ago. The introduction of new materials permitted the speeding up of industry to the point where the stresses and strains thus created advanced beyond the ability of cast iron to function.

Now that the foundries have taken a leaf from the alloy notebook, this ancient material is being produced with physical properties which give alloyed cast iron a strongly competitive position. As a result, the consumption of nickel for alloy cast iron is increasing rapidly, and indicates the growing acceptance by the engineering profession of the fact peculiar to cast iron, that when it is properly alloyed it becomes strengthened, stiffened, toughened, hardened and more generally suited for its work. It is sufficient here to point out that the iron foundries offer to the nickel industry a field potentially as important as those of the structural and stainless steels.

### Plater's Microscope

Several American technical societies recently announced that their tests have definitely demonstrated that substantial coatings of nickel are required to assure practical immunity from atmospheric corrosion. These findings, together with the results of investigations made in Great Britain and on the Continent, are already leading to the widespread adoption of more intelligent plating technique and heavier nickel coatings. This trend has been further stimulated by the development of a plater's microscope with which it is possible to measure accurately the thickness of electrically deposited metal. Formerly this value was arrived at through calculation and, because of variations in the thickness of the deposit, due to the contour of the plated material, it was not always accurate. Probably the outstanding development in this field has been the perfection of the process for bright nickel plating. The main cost factor in electroplating has been the grinding and buffing of the article prior to plating and the final buffing thereafter. In this new process the initial buffing is simplified and the final treatment is eliminated. The deposit is laid down at a faster rate, and the metal to which it is applied can be shaped without serious impairing of the finish. Some rather startling reductions in final costs have already been effected by this process, and the indications are that it will be widely adopted, not only in automobile production, but also in the fields of builders' hardware, household equipment, etc.

The tonnage of nickel used as nickel anodes for electro-deposition during the first nine months of 1935 increased substantially over that for the corresponding period of 1934. Considerable work has been done to improve the quality of the rolled anode, and it now may be considered the most uniform and highest quality nickel anode on the market. This recent work has both improved the solubility of the anode and decreased the possibility of "rough work," a feature of special interest to the plater.

### Monel Metal

Among the non-ferrous alloys, Monel metal has further strengthened its traditional position by the development of the "K" and "S" series. "K" Monel now offers to the engineering and manufacturing industries a combination of physical properties, which opens up applications for a high-strength corrosion-resisting alloy. "S" Monel, with a silicon content higher than that of regular monel metal, is being successfully cast as valve trim for steam lines in power plants and locomotives, as burner tips in oil refineries where the fuel is an acid sludge, as valve steam guides on radial air-cooled aeroplane motors, as valves and seats for soot blowers, and similar applications. Its greater hardness and resistance to wear and to steam and other types of erosion, and its non-galling characteristic at high temperatures are the outstanding advantages of this new product.

Among the bronzes of the structural grades there has been a definite trend toward the use of nickel with tin to improve mechanical properties and to lower production costs. The practice is also expanding of making small nickel additions to high lead bronzes to prevent segregation, or "lead sweat," and to improve resistance to compression.

### Nickeliferous Light Alloys

The attractive features of nickel-bearing aluminium alloys are gaining greater recognition, the principal applications to-day being pressure die castings, aircraft pistons, cylinder heads and motor vehicle pistons. Such alloys have excellent casting qualities and good surface finish and machinability. A light aluminium alloy containing nickel has been developed recently by the Aluminium Company of America. The coefficient of expansion of this alloy is less than that of unalloyed aluminium; consequently pistons made from it can be more closely fitted to cast-iron cylinders. Since the co-efficient of this nickel aluminium alloy approximates to that of Ni-Resist cast iron, these two types of alloys are often used together to advantage.

The following summary of the year's developments affecting nickel is based on material in the files of The International Nickel Company of Canada, Limited, and of The Mond Nickel Company, Limited. These data include the proceedings of various technical societies and reports from the Nickel Information Bureaux.

### Nickel Alloy Irons

Consumption of nickel by the iron foundries showed growth in 1935. Although the tonnage used in this field cannot be compared, as yet, with the consumption of the metal by the steel makers, evidence is accumulating that cast iron is rapidly gaining a more important position in industry, and that this change is due largely to the use of nickel as an alloying element. The development of alloy steels may well be paralleled in alloyed cast irons.

When foundrymen now convene there is an acceptance of the alloying principle, and discussion embraces details of production, treatment and applications of alloyed cast irons. Addition agents containing nickel facilitate the production of alloy cast irons with existing foundry equipment, and are a contributing factor in this development.

Among the industries already committed to alloy cast irons, the motor vehicle continued this year as the largest single consumer, the increase in the number of engines produced having added materially to the amount of nickel used in this form. Recent progress with brake drums has practically eliminated all but those of cast iron, and there is a growing acceptance of nickel alloyed compositions. A similar future can be predicted for camshafts, some which now are made in a high duty, wear-resisting composition ready to serve "as cast." Certain manufacturers of large Diesel engines are now using alloyed iron crankshafts, and further progress is in prospect for crankshafts alloyed to possess high strength, toughness and hardness, and ready for service without need for expensive heat treating and straightening processes. The uniformity in expansion of Ni-Resist and aluminium is encouraging the application of these materials in composite construction of engines, pumps, air compressors, pistons, exhaust manifolds, valve seats and valve guides for automotive service.

The trend toward increasing the accuracy of machining operations, even to the extent of air-conditioning shops to eliminate dimensional changes due to temperature variations, has led machine tool manufacturers to the realisation that the greater stiffness of alloyed cast iron and its damping capacity in extinguishing vibrations, enable the builder of a machine tool to meet the demand for greater accuracy of performance.

Renewal of agricultural purchasing power has revived the implement business. Although dormant for several years, this industry has been actively engaged in studying materials. As a result, alloyed cast iron is being used for gears, frames and other strength- and wear-resisting parts; while corn huskers, grinders and plough parts are being developed in the special abrasion-resisting composition of cast iron, Ni-Hard.

Because most food products corrode ordinary cast iron, Ni-Resist is being used in increasing volume by makers of food processing equipment for such parts as are in contact with foods or beverages, or are subjected to the splash from these products or even are exposed to the humid atmosphere of food-processing establishments. This trend has spread to the manufacture of household equipment, and frying pans, meat choppers, stove parts, etc., are being made from

Ni-Resist; while such other household equipment as grates and furnace pots now incorporate mild additions of nickel and chromium to improve resistance to heat and corrosion.

In the mining industry, Ni-Hard is being used in greater volume for crusher rolls, crusher jaws and cones, ball-mill liners and pump parts; while grinding balls, hardened and alloyed with nickel and chromium, are being produced in quantity. The coal and coke industries are also increasing their use of Ni-Hard for the crushing, processing and sizing of their products, and of Ni-Resist for application in the corrosive and heat conditions of by-product units.

In the metal industries, rolls of Ni-Hard and associated compositions are now commonly employed in the production of both hot-rolled and cold-rolled strip and sheet from such metals as steel, brass, aluminium and copper. The greater strength and hardness of this chill-cast material permit its use for heavy reductions and wide surface sheets. Progress toward continuous, automatic mills for rolling strip and sheet in considerable width is creating a use for alloyed iron compositions not only for the reduction rolls, but also for run-out and conveying rolls.

The general need in the oil-refining industry for better materials has increased the use of Ni-Resist. Introduction of low-temperature purification of lubricating oils has been made practical through the availability of nickel-alloy cast irons and steels for such equipment as compressors, pumps, valves and piping which operate at temperatures as low as – 80 deg. C.

Nickel-alloy cast iron in the moving parts of cylinder assembly on steam locomotives is expected to develop double the mileage formerly obtained, thus opening up an important field for the nickel-alloy irons. Land station and marine installations continue to include heat-resisting types of alloy iron for firebox parts, and Ni-Resist is being adopted where high test, machinable, growth-resisting materials are required.

Steady development in the air-conditioning and refrigeration fields has offered an expanding market for nickel alloy-iron castings for cylinders, pistons and crankshafts in the heavier machinery and for gears, cams, connecting rods and similar small parts in home installations.

The textile, shoe and printing industries continue to use alloyed irons for frames and other parts requiring stiffness and strength, while the heat-treated types of alloys are employed for many of the moving parts. In the textile trade, Ni-Resist has become recognised as an important factor in eliminating staining or colour loss in the processing of fabrics. Practically the full range of nickel-alloy cast irons is employed in the paper industry, which has been active in mechanical developments during the last several years and is now re-entering the market as a purchaser of machinery and equipment.

Consumption of Ni-Resist has increased substantially in many of the chemical process industries, such as oil, coke, gas, salt, soap, edible oils and fatty acids, as well as in paper and textiles. Heavy castings (5 to 10 tons) for large pumps, still parts, filters and condensers, are no longer uncommon. This alloy has also made notable progress as a material for sewage-disposal equipment.

### Non-Ferrous Alloys

Wider appreciation of corrosion problems in industry, development of monel metal with high physical properties, perfection of the processes for cladding steel with Inconel as well as with nickel, improved colour control of the nickel silvers used in architectural trim, and a definite advance in the use of monel metal for several lines of household equipment, all combined to make 1935 an important year for the nickel-bearing non-ferrous alloys. Other contributions to this distinct improvement were the development of the all-metal radio tube and the demonstration that the inclusion of nickel in bronzes makes for economical and efficient product.

Monel metal has strengthened its position in long-established industrial uses, and has found applications in new fields. Its growing popularity in Great Britain and on the Continent led to increases in consumption.

Through welding, a practical method has been developed for fabricating pickling equipment in built-up sections which reduce the deadweight without sacrifice of strength. Sheet and tin-mill crates, wire yokes and other equipment so constructed are finding favour in the steel industry.

### Successful New Developments

To-day more than ever before, monel metal is accepted as the most durable and economical material for the construction of many items of salt-processing equipment. Rotary salt dryers of this alloy now are practically universal, and other important applications are in centrifugal extractors, conveyors, washing and dissolving tanks, filters, hoppers, perforated screens and other accessories.

A new development of the year was the use of monel metal in the chrome process for tanning high-grade leather. A preliminary operation is the treating of the skins in large revolving drums containing a sulphuric brine solution. For the most part these drums have been made of unlined wood. Finding that his rejections ran as high as 20 per cent., a leading manufacturer lined one of his drums with monel metal and found that he had both eliminated rejects and improved the quality of the skins. He estimates that five days' operation of the lined drum paid for the cost of lining. Other monel-metal applications in this and other tanning plants are for bolts and drum hoops.

The high initial cost of the non-combustible synthetic solvents now so widely used for dry cleaning, has made necessary the installation of solvent-recovery apparatus. Due to the highly corrosive nature of the solvents, monel metal has come to be specified as the standard material of construction by practically all the important manufacturers of synthetic dry-cleaning systems. It also is standard for the filter elements used in the pressure filters handling the common petroleum solvents, such as gasoline, benzine and naphtha.

In the latter part of 1934 and early in 1935 attention was focused on increasing safety factors at sea. Among the incidental developments was the introduction of monel-metal water tanks in lifeboats. Even small boat owners evidenced interest in this change, and for the first time monel-metal tanks for both fuel and water were made available to yachts and cabin cruisers.

Another important development of non-ferrous metals in marine service was the increased use of monel metal for various parts of ship-board power plants exposed to contact with salt water. A saving of approximately 35 per cent. in weight as well as an increase in corrosion resistance followed the use of welded condenser heads made of monel-metal sheet. Increased purity in boiler feed water also was effected by the adoption of surge water tanks similarly constructed of this material. Another example of the trend toward weight reduction was the construction from forged and rolled monel metal of air-ports on vessels. Increasing interest continued among small boat owners in the use of monel-metal propeller shafts.

Development of the "K" and "S" modifications of monel metal has led to the use of "K" Monel for wearing sleeves on the shafts of centrifugal pumps and of cast "S" Monel valve trim for parts in the heads of soot blowers.

### Heat-Resisting and Electrical Resistance Alloys

Electrical resistance wires containing high percentages of nickel (60 to 80 per cent.) have provided an outlet for the metal for some time, and production increased during the year. Typical uses range from large industrial electric furnaces to such small household appliances as toasters, electric irons and heaters. Advantages of this high nickel-chromium alloy include strength at high temperatures, low scaling loss and uniformity of temperature throughout individual pieces of equipment, as well as ease of fabrication.

At the same time the use of heat-resistant alloys expanded in industries whose processes include high-temperature and corrosive conditions.

The heat resisting alloys are practically all of a nickel-chromium-iron combination with small additions of other elements which impart special characteristics depending upon the type of application. There are a large number of these alloys, in which the nickel ranges from 10 to 80 per cent., which may be divided into the following types:

| Type | Nickel | Chromium |
|---|---|---|
| 1 | 60-80 | 15-20 |
| 2 | 25-40 | 15-20 |
| 3 | 20-25 | 20-30 |
| 4 | 10-20 | 20-30 |

Alloys of Type 1 are used in applications where toughness at operating temperatures is desired or where the alloy is exposed to carburising materials, as in case-hardening boxes.

Alloys of Type 2 are used in furnace parts in steel, enamelling, petroleum, automotive, and other industries, for high strength or resistance to creep at elevated temperatures is of great importance.

Alloys of Types 3 and 4 find applications where cost may not permit installation or where operating conditions are such as to permit of these lower-alloyed materials.

The principal characteristics which make these alloys useful in industry are the strength and resistance in various atmospheres at high temperature. Conditions of operation may vary widely from highly oxidising to strong reducing atmospheres, which may or may not be contaminated with products of combustion, with either continuous or intermittent operations involving numerous heating and cooling cycles through a wide range of temperature.

In the United States, Canada, Great Britain and on the Continent, most of the large industries, such as power, cement, glass, chemical, ceramic, steel, enamelling, and petroleum, require alloys to meet high-temperature applications, many of which are also highly corrosive.

Before the development of heat-resisting alloys, industrial operations were constantly interrupted by the failure of equipment used at elevated temperatures. One of the outstanding cases is that of the heat-treating boxes which were used for the heat-treatment or case-hardening of small steel parts in the automotive industry. These boxes, which gave a very short life, failed through distortion and burning out because they were used at temperatures above those suitable for steel and, also, because of the numerous heating and cooling cycles which caused the rapid distortion. The use of heat-resisting alloys in this application has reduced the cost of operation and improved the quality of the work.

### Welding Rods

Progress continued in the development of welding of nickel and nickel alloys and in their application in welded structures. Improvements were made in welding technique and in the coated weld rods available.

Reflecting the growing interest in industry, welding clinics were held during the year in various industrial centres. Requirements have become more rigorous with respect to items of design and the perfection of materials and technique. These clinics helped in the dissemination of the latest information available.

Import applications of nickel, monel metal and other high-nickel alloys during the year in welded structures include caustic evaporators,

tank cars for phenol, autoclaves, pickling equipment in metal finishing, reaction vessels for synthetic plastics, dye tanks, condenser heads and surge tanks on ships, etc.

Nickel steels with 2 to 3 per cent. nickel continue to be applied in welded pressure vessels for low-temperature dewaxing operations in the oil industry. Shot-welding of nickel-chromium stainless steel continues in the construction of light-weight, streamlined railroad equipment. Steel-weld rods containing nickel were utilised in welding high-strength steels in ship construction.

### Nickel in Railway Construction

The nickel industry participated in developments in the railway field, including preliminary applications in lighter-weight construction of rolling stock.

In Great Britain nearly 400 steam locomotives using nickel-steel boiler plate are in operation or under construction. The Belgian State Railways are building fifteen Pacific-type engines in which nickel-steel boiler plate 18 mm. in thickness allows for a unit pressure of 18 kg., as compared with 14 kg. allowed by the 19-mm. ordinary plate formerly used. Canadian and American railroads used similar specifications.

Both the Canadian Pacific and the Canadian National railroads used nickel-steel forgings on steam locomotives, and progress was made during the year in the application of low-carbon nickel-steel forgings in electric engines.

Applications of nickel-manganese cast steels were extended to include light-weight railway-car castings. They have consistently met the following minimum specifications:—Yield point, 26 tons per sq. in.; tensile strength, 40 tons per sq. in.; elongation in 2 in., 24 per cent., and reduction of area 50 per cent. An initial order already completed comprised 400 frames, 200 bolsters and 200 coupler yokes. Another order completed during the year specified nickel-manganese cast steel for the truck side frames, bolsters, yokes and draft-gear barrels of 25 cars.

Fatigue tests on full-sized frames gave results fully equal and in some cases superior to those obtained from steels heretofore employed for similar castings. Experience showed that uniform results could be secured, that the nickel-manganese steels reponded well to conditions of manufacture in commercial foundries and that they did not have to be subjected to special processing technique.

It is reasonable to believe that, as soon as a favourable adjustment is made in the economic structure of the railways, the industry may become a large user of nickel-alloy steel castings.

Further progress for nickel cast iron is in sight in the railway industry. To obtain longer service cylinders, bushings, valve cages, and piston rings are to-day alloyed, as are cross-head shoes, grate bars and the like.

The United States has become, in effect, a railroad laboratory testing the relative merits of new types of railroad passenger equipment. Among others, the Burlington road is operating its streamlined, Diesel-powered twin Zephyrs, which are built of light-sectioned stainless steel. The Milwaukee is operating two new semi-light, semi-streamlined trains, powered by oilburning steam locomotives and known as the Hiawathas. Other major railway systems are likewise engaged in determining economies to be derived from new design of both power and rolling-stock equipment. Comparative statements of revenues and expenses recently compiled show that these new-type trains are profitable.

The French State Railways have placed an order for forty stainless-steel cars in two-car units mounted on three trucks. It is estimated these will require 500 metric tons of stainless steel of the 18/8 type. The cars are intended for suburban and through service on the Paris-Le Mans line, which is to be electrified. Each two-car unit will have a total capacity of 300 passengers, and will weigh but sixty tons. The frame, of tubular construction, will weigh twelve tons.

Typical of the general movement to increase passenger comfort is the attention that has been devoted to improving dining-car service. Among the interesting features evolved in this connection is the combination table-counter service car which has begun to appear on several American railroads. An illustration of this is the diner on the "Royal Blue," the Baltimore & Ohio flyer operating on the New York-Washington run. The car departs from conventional design in having its kitchen in the middle with table service at one end and counter service at the other. The kitchen walls and ceiling, as well as its equipment, are of monel metal.

Air-conditioning, which was installed first in diners, has now become standard equipment for passenger cars on through-line trains. Nickel cast irons are finding applications in the machinery, and Edison nickel-ore storage batteries are frequently included in the installations.

### Marine Engineering

The wide use of nickel for marine purposes is illustrated by the Normandie. This French liner has nickel-chromium steel turbine and blading, 2 per cent. nickel steel for bolts and studs on high-pressure super-heated steam lines and 5 per cent. nickel steels for expansion-joint fittings. The shafts are of nickel-chromium steel. Chromium-nickel stainless steel of the 18/8 type was used for decorative fittings, hardware and finishings, including bath fixtures, mouldings, lighting fixtures, beds, modern furniture, galley equipment, metal ware, railings and the name on the bow in letters three feet high. Nickel silver was used for plumbing fixtures and allied items. Monel metal went into valve trim, turbo-feed pump blading, discs and valves, refrigerator trim, etc. Auxiliary condenser tubing was made of 70-30 cupro-nickel. Nickel alloys will be used extensively in several ships now building or soon to be built in France.

Progress was made in 1935 in employing the 70-30 alloy for castings for valves and fittings.

Nickel cast iron is also finding applications in marine construction. One of these was the world's smallest outboard motor which develops 3.7 h.p. at 4,000 r.p.m., though it weighs only 37 lbs. Ni-Resist sleeves are used in the aluminium cylinder block.

### Machine Tools

Machine-tool manufacturers increased their demand for nickel steels to keep pace with developments in their industry and in addition have turned to the nickel cast irons for a number of applications.

Improvements in tool materials and the machining of harder metals have led to increasing speeds in machine-tool operation and the use of more powerful motors. These in turn have caused a demand for stronger and tougher metals for gears, shafts and other members which must resist high stresses. Machine-tool manufacturers, therefore, have adopted alloy steels, especially those containing nickel, for gears, spindles, clutches, dogs, racks, worms, levers, arbours, shafting, feed stop rolls, collets, couplings and highly-stressed studs, washers, nuts and bolts. Anti-friction bearings of nickel steel have also been adopted.

Producers of machine tools and other heavy machinery have recognised the value in terms of strength, toughness, stiffness and wear resistance of high-test nickel-alloyed irons for parts of their equipment. The trend towards increasing the accuracy of machining operations has progressed even to the extent of air-conditioning shops to eliminate dimensional changes due to temperature differences. The greater stiffness of alloyed cast iron plus its damping quality, or capacity to extinguish vibrations, enable the machine builder to help to answer the requirements of greater production accuracy.

High-duty nickel-chromium-molybdenum cast iron has been used for knuckles on large presses, where it withstands severe service tests. Progress has been made in the adoption of Invar-type nickel cast iron (30 to 34 per cent. nickel) for certain types of dies that must be heated during operation.

### Rolling Mills

Nickel-alloy steel castings of the pearlitic-nickel-manganese type are used in quantity in the construction of rolling-mill machinery. A very large machine for bending, flanging, forming and multiple punching steel plates has recently been completed. Constructed to handle steel plates up to 1 in. in thickness in lengths up to 12 ft. and steel plates ¾ in. in thickness up to 18 ft. in length, the machine incorporates many important parts made of heat-treated nickel-alloy steels. The total weight of the machine is approximately 64 tons.

In the metal industries as a whole, machine frames and dies of cast or heat-treated alloy iron are now commonly employed where such properties as strength, hardness and resistance to deformation are essential. Rolls made of Ni-Hard and associated compositions are used in the production of both hot- and cold-rolled strip and sheet for metals such as steel, brass, aluminium, zinc and copper. The greater strength of the chilled-cast material permits its use for heavy reductions and wide surface sheets.

Progress in rolling-mill construction toward automatic mills for rolling sheets and strip of considerable widths has stimulated the application of high-grade nickel-alloy iron compositions for reduction, run-out and conveying rolls.

### Chemical Industries

There has been a steady expansion of the use of nickel in the viscous-rayon industry, which demands freedom from metallic contamination. Here nickel is used for vacuum crystallisers in the recovery and concentrating of chemicals from coagulation bath liquor.

Ni-Resist increased its usefulness in many of the chemical process industries, including oil, coke, gas, soap, paper, edible oils, fatty acids and textiles. Castings of 5- and 10-ton weights are regularly employed for large pumps, still parts, filters and condensers.

Ni-Resist pipe produced by the DeLavaud centrifugal process is now available on a commercial basis. This opens up a market for the handling of corrosive industrial waste and by-product liquors. Ni-Resist has made progress as a material for sewage-disposal equipment and has proved to be superior to ordinary iron for vapour boxes, charging doors, rings, ells, tees and baffle plates in garbage-disposal plants.

### Miscellaneous

Numerous miscellaneous items illustrate the variety of uses to which nickel alloys are put. Among them are the following:—A stainless-steel tennis net, said to eliminate all the faults found in ordinary nets, has recently been announced. It will not sag, stretch, rot or tear, and it can stand the strain of fast play without injury to itself, the ball or the players. It does not have to be taken down after play, and, since the 18/8 material of which it is made is resistant to corrosion in all kinds of outdoor atmosphere, it can be left in place throughout the season.

Fire-engine bells cast of copper alloyed with 20 to 22 per cent. tin, with a small amount of silicon, have been found to crack after a short time in service. This difficulty has been overcome by replacing 2 per cent. of the tin with nickel.

Practically the full range of alloyed cast irons is used in the paper industry. This field has been active in mechanical improvements during the past five years, and revival in business has stimulated the consumption of alloyed irons.

# The Pig-Iron Situation in 1935

## By The Hon. ROBERT JAMES (Chairman, Barrow Hæmatite Steel Company, Limited)

ALTHOUGH the final trading figures for the year just ended are not available, it seems certain that the 1935 pig-iron output will have shown a distinct improvement on the previous year. Even twelve months ago it was evident to all that the industry had at last begun to share in the general trade recovery of the country.

This improvement has been largely due to four main causes—the benefit of protective tariffs, the boom in building, the partial revival of shipbuilding, and the accumulated arrears of capital expenditure. During the next four or five years we may reasonably anticipate a further improvement. For instance, the total January production of pig-iron was 520,000 tons, and by October it had risen by only 30,000 tons, while on the ingot production of the same eight months an increase of 350,000 tons was recorded. As also the shortage of scrap has further reduced the price margin between it and pig-iron, we must assume that the steelmaker must look to pig-iron to meet any further expansion of his trade.

*Production of Foundry Iron in the United Kingdom, showing Tonnage and Percentage of Total Pig-Iron Production in each year from 1929 to 1935.*

| Year. | Output. | Percentage of total pig-iron. |
|---|---|---|
| | Tons. | Per cent. |
| 1929 .. .. .. | 1,469,300 | 19.4 |
| 1930 .. .. .. | 1,433,600 | 23.1 |
| 1931 .. .. .. | 1,153,600 | 30.6 |
| 1932 .. .. .. | 1,020,100 | 28.5 |
| 1933 .. .. .. | 929,100 | 22.5 |
| 1934 .. .. .. | 1,275,500 | 21.3 |
| 1935* .. .. .. | 1,325,800 | 22.6 |

* Estimated on 11 months.

The day has passed when founders were content to purchase iron to fracture. Each foundry and steel manufacturer now requires a specialised product, a pig-iron where each element is exactly specified. The task imposed on the ironmaster is more exacting as each year passes. This requires of the blast-furnace owner, not only close attention to his practice, but also a careful selection of his raw materials, for it is only possible to take out of a furnace what you have put into it.

*Imports of Foundry Pig-Iron into the United Kingdom for the last Five Years.*

| Year. | Tons. |
|---|---|
| 1931 .. .. .. .. .. .. | 109,265 |
| 1932 .. .. .. .. .. .. | 29,899 |
| 1933 .. .. .. .. .. .. | 37,680 |
| 1934 .. .. .. .. .. .. | 30,785 |
| 1935 (estimated) .. .. .. .. | 21,000 |

*Exports of Foundry Pig-Iron from the United Kingdom for the last Five Years.*

| Year. | Tons. |
|---|---|
| 1931 .. .. .. .. .. .. | 80,071 |
| 1932 .. .. .. .. .. .. | 72,191 |
| 1933 .. .. .. .. .. .. | 51,735 |
| 1934 .. .. .. .. .. .. | 73,426 |
| 1935 (estimated) .. .. .. .. | 94,810 |

To reap any benefit from this specialised demand, the manufacturer of to-day must possess improved blast-furnace plants, modern units designed for economic production and improved qualities.

During recent years the demand, such as it was, was mainly for the commoner grades of pig-iron. Now, however, we seem to be face to face with a rearmament programme for which, in many instances, only the highest qualities of pig-iron are acceptable. It seems, therefore, reasonable to assume that the demand for the high-grade West Coast iron may possibly be even greater than that produced in other districts. The Washington Naval Convention dealt the West Coast a severe blow. Blast furnaces went out of production and the Cumberland and Furness district iron-ore mines had their outputs seriously reduced. Now, however, there is a real prospect of the position being reversed, and of seeing the pig-iron industry on this coast resume its former activities. Should this come about, it must surely be a matter of general gratification, because not only will it help to bring prosperity to those engaged in the pig-iron industry, but also find work for many unemployed in a district that is scheduled as a distressed area.

*Monthly Production of Foundry Pig-Iron in the United Kingdom during 1935.*

| Month. | Tons. |
|---|---|
| January .. .. .. .. .. | 118,800 |
| February .. .. .. .. .. | 100,000 |
| March .. .. .. .. .. | 112,300 |
| April .. .. .. .. .. | 120,500 |
| May .. .. .. .. .. | 105,400 |
| June .. .. .. .. .. | 104,700 |
| July .. .. .. .. .. | 102,700 |
| August .. .. .. .. .. | 122,200 |
| September .. .. .. .. .. | 115,600 |
| October .. .. .. .. .. | 105,100 |
| November .. .. .. .. .. | 108,000 |
| December (estimated) .. .. .. | 104,000 |

## Book Reviews

**The International Mercantile Diary and Year Book 1936.** Published by Syren & Shipping, Limited, 44/46, Leadenhall Street, London, E.C.3. Price (including quarterly copy of "The Merchant Shipper"), 10s. 6d., post free.

All foundries interested in the export trade should provide themselves with a copy of "The International Mercantile Diary and Year Book," the twentieth annual edition of which has just been published. It comprises a complete guide to exporting goods of all kinds; a desk diary, and a compendium of valuable commercial information in one volume.

The international section deals with every country in the world in turn, giving in the simplest possible language everything the exporter wishes to know about sending goods or postal matter all over the world. Among the many features are consular, customs and imperial preference regulations; particulars of consular documents required, with facsimiles; legalisation fees; packing and marking of goods; regulations for commercial travellers and samples; patent and trade mark laws; foreign consulates in Great Britain, and British consulates, trade commissioners and imperial trade correspondents abroad; principal banks; holidays; currency values; weights and measures; postal information (letters, small packets, parcels, insurance, air mails, money orders, cables, letter telegrams, and telephones); imports and exports; chambers of commerce; and sailings of shipping lines from the United Kingdom. This section also contains comprehensive lists of the populations and industries of towns in Great Britain, forwarding agents, shipping lines serving British and overseas ports, the principal British, Colonial and foreign banks, and the United Kingdom import regulations.

There are two other sections: the diary, which shows a week to an opening on good writing paper; and over 40 pages of metrical and other conversion tables, calculators, weights, measures, calendars, monetary values and useful formulæ.

The publication is unique, for not only does it contain a wealth of valuable information which is not to be found elsewhere in one volume, but it is kept up to date throughout the year by a quarterly supplement, "The Merchant Shipper," which is posted free of charge to all subscribers in January, April, July and October, and gives all alterations in regulations, rates, etc., occurring in the intervening months. The "Year Book" is thus an authoritative reference right up to the time of its supersession by the next edition.

**Welding Technology and Design.** By G. F. P. Fox and F. Bloor. Published by Messrs. Chas. Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. (Price 4s. net.)

This book deals in a concise manner with all methods of electric welding. The valuable information given under five chapters will be found of great use not only to the practical welder, but to those who wish to obtain for themselves a general knowledge of welding practice.

The tables giving a comparison between fabricated material and castings are particularly useful, whilst the form and properties of various types of welded joints are dealt with in a manner which leaves little to be desired. The chapter dealing with plant and accessories, whilst naturally brief in a publication of this size, gives one a very clear insight into welding plant in general. A little more space might profitably have been given to the metallurgical aspect of welding, for welding is essentially a metallurgical operation, but it speaks well for the authors that they have at least not ignored the importance of metallurgical examination of welded joints or fabricated material.

The book is well printed and the illustrations good, and it may be said without question that it is a valuable addition to the many publications given to the art and science of welding.

J. H. A.

## Refractories Industry in 1935

(*Concluded from page 32.*)

dolomite bricks is likely to enhance their importance, as these bricks may, at any rate in part, replace magnesite bricks which are either imported or are made here from imported raw material.

On the non-ferrous side increasing use is being made of sillimanite refractories. Ten years ago this mineral was of little commercial importance, but now, owing entirely to research work and its industrial application, very large tonnages of it are being used.

In connection both with the manufacture of refractories and the study of their attack by slags, some of the recently published phase diagrams are of fundamental interest. The investigation of the system $CaO$-$FeO$-$SiO_2$ has, for example, provided data of importance in connection with the reactions between silica bricks and slags. The American Ceramic Society rendered great service by publishing in 1933 a compilation of nearly 200 of these phase-rule diagrams of particular importance in connection with the making of refractories and their behaviour in service.

# Conditions in the American Foundry Industry in 1935

## By OLIVER SMALLEY (H.B.M. Consul, Pittsburgh)

### National

THE closing months of last year provided definite evidence that 1936 would be a capital goods year. Recovery has been progressing gradually from the consumer trade, through the motor-vehicle industry, until now a definite demand for machine tools and special machinery is in evidence. This activity has been reflected in the foundry industry during the past year by a progressive increase in volume of business from light castings through medium to a heavy class of work.

How much of this recovery is due to Government planning and how much due to the natural forces of world recovery is a subject for economists to debate over. It is a fact, however, that foundrymen in the United States have been closer associated with their government than ever before. Their national trade organisations co-operated with the National Recovery Administration, and by the beginning of 1935 American foundrymen, as a group, were organised and better acquainted with the national aspects of price-fixing, wage differentials and standard costs than anyone would have dreamed was possible in so short a period of time. Unfortunately, due to the adverse decision by the Supreme Court last spring, the wholesale abandonment of the various foundry codes of fair competition under the National Recovery Act was a severe shock, and meant the establishment of another rapid change to survive and meet the new law which demanded free and open competition. These foundry-trade organisations are now busy endeavouring to maintain their present form, and whilst they are not able to carry on as originally intended, are ambitious in the hope of being able to combat unbridled competition, to place the industry on a sounder basis and to lay a groundwork for more profitable operation.

The following programme, proposed recently by the Grey Iron Founders' Society, is typical:

(1) To keep informed and to represent the industry on questions of national legislation affecting directly or indirectly the members of the industry.

(2) To assist members of the industry in regard to proper estimating, cost finding and cost keeping.

(3) To develop and expand castings sales—creating a standard sales contract and standard trade practices.

Active steps are being taken to discourage the importation of castings from foreign countries.

(4) Continue with the further creation of suitable specifications and to educate the engineers, purchasing agents and castings buyers in the use of these specifications.

(5) To collect and distribute statistical information in regard to the industries various labour classifications, wages and hours, and in regard to the industry itself.

(6) To encourage the creation of a national foundry apprentice training course.

### Manufacturing Steel Castings

There have been no worthwhile metallurgical developments this year. During 1935 costs of raw materials advanced some 14.6 per cent. and labour 5.7 per cent., whilst selling prices dropped some 2 per cent. This has necessitated a concentration of the efforts of the industry on small economies and an expansion of castings sales. On the whole, there has been an extension of electric melting and a trend toward lower power costs. The extension and flexibility of the electric furnace have also aided in the further development of high-strength alloy steel castings in individual foundries and in the introduction of the better-known corrosion- and heat-resisting alloy steels.

Two new steel-casting specifications have been tentatively adopted by the American Society for Testing Materials. These two specifications refer to Carbon Steel Castings for Miscellaneous Industrial Uses (A180-35T) and Alloy Steel Castings for Railroads (A87-35T). Prior to the adoption of these two specifications there was only one covering carbon-steel castings for miscellaneous uses. The trend now is away from an all-inclusive specification and toward separate considerations of steel castings for industrial, railway and marine work.

### Malleable

The adoption of the Brackelsberg furnace, as the fulfilment of the malleable foundrymen's necessity for lower melting costs than are possible from the air furnace, is perhaps the most important development in the industry. About a dozen installations were made last year. 1935 has also seen a continuation of the trend toward further reduction of annealing time to reduce costs and expedite delivery. The so-called high strength malleables have seen further expansion, but there has been no noteworthy technical development.

### Grey Iron

Grey-iron foundries have been especially active in retaining their specialty business during this period of increased tonnage and better prices. Improved selling prices have not been entirely a function of a rising economic cycle, but rather to the fact that users are getting more for their money than before. Needs for special equipment have extended the use of superior grey iron, where its new properties and uniform structure recommend it for engineering constructions designed to precise formulæ. A twenty-two tons per sq. in. tensile iron with a Brinell hardness within the range of 207 to 241 in the as-cast condition is commercially produced. Reduction in weight of castings as high as 57 per cent. over older designs made of ordinary grey iron may be cited. Incidental, but most practical from the standpoint of the extended use of grey iron, was the Machine Tool Show at Cleveland, Ohio, last year, where about seven acres of floor space were devoted to the display of foundry products in the form of modern machines. The acceptance of such a material by engineers, who have so long been exposed to high powered propaganda from manufacturers of rolled, welded and formed metals for so many years, is a fact of which the industry may well be proud.

The dynamic properties of superior irons have been brought to the attention of engineers and engineering societies in America. High fatigue limits and the fact that grey cast irons retain their efficiency in damping vibration at high stresses have been presented with a view to interesting diesel, locomotive and motor vehicle builders.

Of importance in the presentation of data to founders and engineers was the recent publication of the Cast Metals Handbook by the American Foundrymen's Association. There has also been the activity of individual concerns and various foundry societies in co-operating with the American Society for Testing Materials and American Standards Association to promote modern specifications.

### Labour

Restriction of immigration, a moratorium on apprentice training during the past five years, and unprecedented depression has brought out the fact that the foundry industry is under-recruited in trained man power. A detailed programme of a four-year foundry apprenticeship course intended to fill this need was presented early last year under the joint sponsorship of the American Foundrymen's Association and the National Founders' Association.

### PROSPECTS FOR 1936

Recovery in general business in the U.S.A. during the past year has been confined largely to consumers' goods trade, and many companies have found their present facilities inadequate to meet the growing demand. As a result, the machine tool and industrial machinery business has expanded in recent months, and indications are that machinery purchases will continue in increasingly greater volume during 1936.

### Machinery

At the Machine Tool Convention in Cleveland during September of last year, some 233 companies displayed equipment. The automobile industry and metal working machinery accounted for the major share of increased machine tool orders.

### Motor Vehicle

The 1936 motor vehicle season has officially begun. Production which has been rising for several weeks is expanding further, and it is estimated that domestic consumption of motor cars and lorries will exceed over 4,000,000. A considerable expansion of foreign sales is also anticipated. In 1932 America exported 182,000 motor vehicles. It is estimated that over 650,000 will be exported in 1936.

### Railways

There is increasing evidence that capital expenditure for railway equipment will show some improvement, with railways showing an earning increase of 50 per cent. The Pennsylvania Railroad has a plan for a $30,000,000 freight car building and repair programme, including the construction of 10,000 cars and 100 locomotives. The Burlington and other railroads also plan construction of goods wagons, locomotive and other equipment. This means substantial casting business in the way of frames, wheels, brake shoes, engines and miscellaneous carriage castings.

### Building

The building industry, which has seen some progress in 1935, will record further gain, and public work will expand as a result of large Federal expenditures.

### Electrical Machinery

The rise in electric power production is taxing the facilities of power companies, and demand for central station equipment, which has been at a low ebb since 1929, is expected to assume large proportions.

### Agricultural Machinery

The Agricultural Adjustment Act, emphasising production control and bounty payment, although unsound economically, has replenished the lockers of the farmers, and further expenditures in farm equipment is anticipated.

The steel industry transformed a large loss in the third quarter of 1934 into a fair sized profit in 1935, reflecting substantially higher operations.

Contracts have been awarded on twenty-three naval vessels. A total of eighty-six naval vessels are now under construction, mostly destroyers

(*Concluded on page* 42.)

# The Czecho-Slovakian Foundry Industry in 1935

## By Professor Dr.-Ing. Fr. PISEK (President of the Czech Foundrymen's Association)

THE improvement in the Czecho-Slovakian foundry industry which made itself felt towards the end of 1934 continued with some slight interruptions during the whole of the year 1935. Towards the end of 1935 the production was on a higher level than it was towards the end of the preceding year. The foundry industry in this respect followed the upward trend of the whole of the Czecho-Slovakian industry.

The production of grey iron increased on an average by 15 to 20 per cent. compared with the average output in 1934, some types of castings benefiting much more than others. For instance, the production of castings for the construction of machinery as well as that of high-grade castings, motor-engine cylinders, etc., increased considerably. A distinct improvement was registered in the output of grey iron by those foundries manufacturing small machines for household use and similar accessories.

### Cast-Iron Pipes

The foundries making cast-iron pipes were hard hit because of the poor state of the finances of the municipalities and public works authorities. Foundries making fall pipes and radiators (light castings) were also short of work, as very little building was undertaken in Czecho-Slovakia last year.

The malleable-iron foundries were busier last year than in 1934, and in some foundries the output nearly reached the normal output they had before the crisis.

### Steel and Non-Ferrous

Good business was experienced by foundries producing large shipbuilding castings, such as stern posts and rudder frames, etc. These foundries worked chiefly for the export trade. The foundries engaged upon small and medium-sized steel castings also enjoyed increasing prosperity.

Non-ferrous foundries are, in general, working to the same capacity as last year; only a few foundries making specialities are fully employed. The production of light alloy castings has greatly increased, especially in certain directions.

### Selling Prices

In spite of the increase in production during 1935, the selling prices did not improve, and some foundries sold their products considerably below their cost price. This led to negotiations being started in 1935 to regulate prices, as it is well known that price-cutting has no beneficial influence on employment. The great difficulties to be associated with negotiations lasting over prolonged periods, often forgetting the issue at stake, made agreement almost impossible, and it was necessary to re-establish confidence.

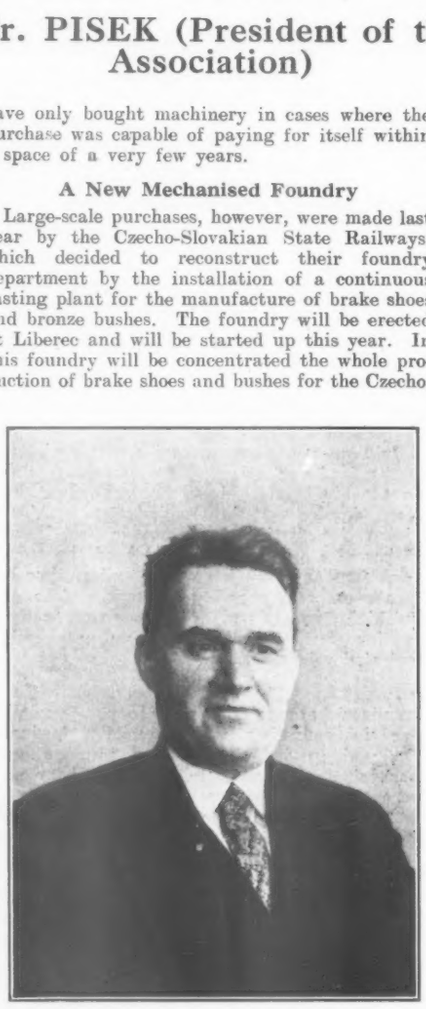
An agreement on the prices of radiators was quickly reached; the prices for a square metre of heating area rose from 41 Kc. to 75 Kc. In this section of the foundry industry the struggle for business assumed such proportions that the loss these foundries suffered during the crisis reached 32 million Kc.

A price agreement was reached for consumers' castings and negotiations are in progress for the establishment of a price list for machinery castings. An agreement was also reached for prices for malleable castings, but negotiations for steel castings have yet to be started.

Certain foundries engaged on consumers' castings were obliged to shut down as a result of the crisis. A further effect of the crisis is the lack of reserves within the industry. The foundries have only bought machinery in cases where the purchase was capable of paying for itself within a space of a very few years.

### A New Mechanised Foundry

Large-scale purchases, however, were made last year by the Czecho-Slovakian State Railways, which decided to reconstruct their foundry department by the installation of a continuous casting plant for the manufacture of brake shoes and bronze bushes. The foundry will be erected at Liberec and will be started up this year. In this foundry will be concentrated the whole production of brake shoes and bushes for the Czecho-Slovakian State Railways. The foundry will be completely mechanised and the most modern equipment will be used.



PROF. DR.-ING. FR. PISEK.

### Raw Materials

Raw-material prices were unchanged with the exception of some minor commodities. The increased output of the foundry industry caused the Prazská zelezárská spolecnost in Kladno to engage upon the production of a foundry pig-iron having a medium phosphorus content—a product which, hitherto, has been made solely by the Vítkovické horní a hutní tezírstvo at Vitkovice and by the Banská a hutní spolecnost at Trinec.

### A New Amalgamation

It is of considerable interest to announce that the well-known die-castings manufacturer, Ing. Josef. Polák, has amalgamated his interests with the firm of Krizik-Chaudoir, who are equally well known in the stampings field. This amalgamation will eliminate the former competition which existed between die castings and drop forgings, thus making it possible for the buyer to choose the more suitable material for any particular job.

Special efforts have been made by the Czecho-Slovakian industrialists to improve the quality of their production, and a particular interest has been taken in high-duty castings in steel, brass and bronze. Competition from weldings is diminishing, the craze for welding everything has gone, and it is only employed in such cases where outstanding economies are indicated, or where it is obviously better.

Efforts directed towards the creation of an over-riding association for the foundry industry have been successful, and there has been established at Prague the "Sdruzení kovodelného prumyslu csl," which body is the joint responsibility of all foundries.

### Technical Developments

The Czecho-Slovakian Foundrymen's Technical Association has co-operated cordially with the Czecho-Slovakian Standards Institute. An agreement has been made with the Institute for the standardisation of foundry sands, and this co-operation has been extended to include the quarry owners, and one of the objects of this is the specification of conditions of delivery. The conditions are at present tentative, but after a period of experiment they will be standardised.

The desire to provide improved technical instruction for foundry apprentices has resulted in the establishment of special technical training centres in several districts. The complete scheme provides for schools to be established at Prague, Plzen, Brno and Moravská Ostrava.

### Educational Activities

Of outstanding interest was the participation of 23 members of the Czecho-Slovakian Foundrymen's Technical Association in the Brussels Congress last year. Several scholarships granted by the Czech Association enabled a number of poor but deserving members to attend.

The immediate future of the foundry industry is distinctly favourable. New building legislation will make for increased employment in the light-castings foundries. The construction of a large pipe-line is scheduled which will no doubt be helpful to the large cast-iron pipe foundries. A well-planned programme of industrial research and vastly-improved credit facilities are amongst the outstanding pieces of industrial legislation which came into force with the New Year, and which cannot help but react favourably upon both the engineering and foundry industries.

In the near future a Czech art foundry will have the privilege of casting the statue of General M. R. Stefanik to the design of Professor Kafka. It will form part of the big monument to be erected to General Stefanik in Bratislava. This statue—a figure in air-pilot's dress—will be cast in bronze, will be 9 metres high and weigh about 80 metric hundredweights, and will conform to the high standard of Czecho-Slovakian art.

---

## American Foundry Industry

(*Concluded from page* 41.)

and submarines, but this includes three aircraft carriers, three heavy cruisers, and eighty light-cruisers.

The heavier industries have made some progress this year, though they are still severely depressed, but it is believed that 1936 will show substantial progress.

All of these mean further improvement of the foundry industry in all its ramifications. Unfortunately, with virtually the entire list of New Deal Laws on the Calendar of the Supreme Court being tested for "constitutionality," business over the next year will be influenced by court decisions and legislative proposals for new laws.

# The Foundry Industry in Sweden in 1935

## By Professor SIXTEN O. V. NILSSON

AS far as the author is aware the Swedish foundry industry has never been represented in any previous annual review of THE FOUNDRY TRADE JOURNAL, and when Mr. Faulkner asked for an account of this industry it was decided to commence by giving readers a general survey followed by some notes on the present situation.

The Swedish foundry industry is not the result of any five-year plan of modern conception. It is, on the contrary, an industry developed from the operation of the old small charcoal blast-furnaces. The earliest castings were made from iron direct from furnaces located close to some waterfall or mine, and even to-day in some places in Sweden there are foundries situated in the vicinity of these old blast furnaces which still stand as memorials of days long ago. All the larger ironworks are usually equipped with large or small iron or steel foundries, the main object of which is the production of castings for their own consumption, for spare parts and new constructions, but there are also a few which undertake jobbing lines.

During the latter part of the 19th century and the earlier part of the 20th century a number of engineering industries were established with iron and brass foundries as departmental shops.

The foundries are situated in or just outside towns or larger communities and their products are intended mainly to fill the need of their own works, but they also execute orders from other concerns. The number of independent foundries or general jobbing foundries is very small.

The different origins of the foundries has caused on both sides a certain isolation between the two groups which in certain cases has been rather a disadvantage. An organisation similar to the Institute of British Foundrymen simply does not exist. Labour problems connected with the engineering industries are handled by "Sveriges Verkstadförening" (the Engineering Association of Sweden) while "Sveriges Maskinindustriförening (the Machinery Manufacturers' Association of Sweden) takes care of other matters. The latter has a department for foundry technical problems.

GARDEN URN DESIGNED BY IVAR JOHNSSON AND CAST BY NÄFVEQVARNS BRUK.

Labour problems and other matters concerning iron and steel works are divided in a similar way between two other associations. Most of the foundry engineers, superintendents and foremen are members of "Sveriges Gjutmästareförbund" —which is a Swedish foundrymen's association—whose official organ is "Gjuteriet," the only journal of its kind in Sweden. The iron and steel foundries number about 300, a dozen of which have a capacity of more than 3,000 tons per year. The total production of castings is estimated to approximately 200,000 tons a year.

PROFESSOR SIXTEN O. V. NILSSON.

It might be of interest to English readers to learn that many of the Swedish foundry technical terms are the same as those in the English language, whilst the Norwegian and Danish expressions resemble those of the German language. This is probably due to earlier close connections with the engineering and foundry industries of England. In fact, the first Swedish steam engine was built by an Englishman (Welshman?) called Samuel Owen.

### Foundry Raw Material

In spite of the fact that Sweden is one of the countries producing pig-iron, large quantities are imported, particularly from Germany and Holland. In 1934 the imports of pig-iron totalled 80,000 tons. The bulk of the imports consists of high-phosphorus pig-irons, produced by coke-fired blast-furnaces. These irons are generally used in mixtures for machinery and light castings.

For castings with special requirements Swedish charcoal pig-iron is used to a great extent in the mixtures, the highest qualities being produced only from such pig-iron, mixed with steel and returned scrap. Even foundries specialising in light castings add a certain amount of charcoal iron in order to increase the strength of the iron.

The supply of coke for the foundries for melting purposes is mainly drawn from imports. This fuel has caused the foundries a great deal of trouble, as it has been practically impossible to procure the same quality regularly. The reason for this condition is probably due to the fact that the quantity of coke consumed by the foundries forms only a small part of that imported for general heating purposes. Special cargoes of real foundry coke are rather rare and the foundries are often compelled to use coke "for heating purposes" when melting. It has long been a desire amongst the foundries to have that position corrected, and any real initiative towards amelioration would be greeted with enthusiasm.

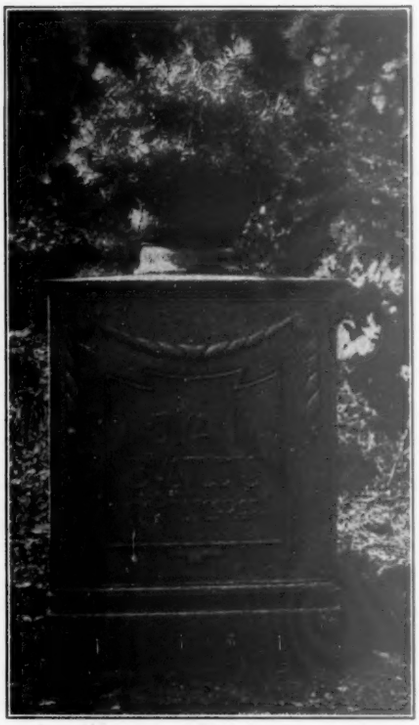
The supply of refractories is drawn mainly from domestic production based on deposits in South Sweden of fireclay of good quality. As to moulding sand, the synthetic variety has for long been in general use in Sweden. The sand found abundantly in the numerous morain ridges, often of such purity that, when mixed with some pure kind of clay, it makes a very suitable moulding material for ironfoundries. It is not highly plastic, but against that its permeability is so great that the venting of the mould is usually not necessary. Consequently, moulding-sand conditioning, as well as the sand-preparation plant, are, of course, adapted to synthetic sand, and differ somewhat from those in other countries with deposits of naturally-bonded sands. Only South Sweden has a natural supply of the latter sand, which is used, although sparingly, even by the foundries of Middle Sweden. Imports of moulding sands exist only to a limited extent.

### Foundry Products

The operation of the engineering foundries is concentrated on the manufacture of castings for their respective factories. Large foundries are thus to be found attached to the shipyards, and the production of the most important castings for steam and Diesel engines and the like has reached the highest standard.

The highly-developed wood and pulp industry demands castings in great quantities. Thus, some foundries are engaged in the production of castings for wood-working and pulp machinery of various kinds. Other quite important foundries are those attached to plants producing turbines, electrical appliances, separators, ball

GARDEN SEAT DESIGNED BY FOLKE BENSOW.



CAST-IRON GRAVESTONE. IT WEIGHS 3 CWTS. AND IS 1 METRE HIGH, THE BASE BEING 590 MM. SQ.

bearings and crude-oil engines. Another large group consists of the foundries for commercial castings, making stoves, ranges, cooking utensils, sewing machines, sanitary appliances, boilers, radiators and castings for building purposes.

The production of art castings from pig-iron is an industry to which a great deal of attention is paid, and which has won world-wide approbation. Besides the various steel castings mentioned above, the ironworks also produce castings of special alloys, particularly those containing nickel and chromium. The malleable-iron foundry industry is carried on by a small number of plants making pipe fittings, shop fittings, castings for agricultural machinery, the motor industry, etc.

Most of the engineering factories are equipped with brassfoundries varying in size. There are also a number of independent foundries making bronze and brass castings, while others specialise on light alloy castings. The method of making pressure die castings from aluminium and brass alloys is carried on in some places.

### Plants and Equipment

As in other countries, there are to be found in Sweden a great variety of foundries, large and small. There are those with excellent modern reinforced-concrete or iron buildings, but there also are those of wooden construction. Foundries built in recent years are of reinforced concrete, and have an abundance of natural and artificial light as well as proper heating and ventilating systems. The mechanical equipment varies from foundries with mechanised operation to those with simple hand moulding. Swedish production is seldom of such an extent that mechanised operation is profitable. Although there does exist a definite mass-production programme for some of the foundries making consumers' castings, the owners are very cautious when it comes to introducing mechanised operation. Due to the fact that there is a considerable variety of castings the production of which is comparatively small, special requirements are demanded from the equipment for mechanised production, and a suitable system has not yet been completely developed. Even the foundries making consumers' castings are still working according to the usual methods, moulding machines being used to a great extent, but hand moulding with hinged flasks and matchplates compete in many districts with moulding machines.

The cupola is still the dominating melting furnace, but electric melting furnaces, either of the Rennerfelt or Heroult system, have been installed in practically all the ironworks, as well as in some of the engineering foundries. High-frequency electric furnaces are also finding favour. Rotary furnaces (Brackelsberg type), fired with pulverised coal, are now in use in three works. Oil-fired rotary furnaces, as well as crucible furnaces, are used in many places for special alloys, particularly those of chromium and nickel.

Although Swedish firms manufacture good foundry machines and equipment of various kinds, foreign machinery is also utilised to a large extent. It is mostly of German and seldom of either British or American origin.

STOVE CARVED OUT IN CAST IRON TO THE DESIGNS OF FOLKE BENSOW AND MADE BY NÄFVEQVARNS BRUK.

### Labour and Vocational Education

The young Swede has a mechanical sense, and it is not difficult to teach him machine-moulding in a short time. Although no laws concerning apprenticeship exist, four years are regarded as the minimum time for a young man to learn the trade.

Apprenticeship schools for moulders do not exist and the foundries themselves have to take care of the recruitment. For those desiring to get instructions and supervised training in applying scientific and technical information germane to foundry practice there are facilities for attending technical evening classes and for those aspiring to a foreman's position a special

CAST RELIEF INSTALLED IN THE ROYAL TECHNICAL SCHOOL, STOCKHOLM. DESIGNED BY IVAR JOHNSSON AND CAST BY NÄFVEQVARNS BRUK.

CAST GARDEN FURNITURE BY NÄFVEQVARNS BRUK.

foundry technical school has been organised by the Swedish Machinery Manufacturers' Association. This school has as its object the acquisition of the fundamental theoretical knowledge necessary for foundry superintendents and foremen. Lectures in foundry technology are held at the Royal Technical University of Stockholm and various foundry technical studies are followed. These lectures are compulsory for those destined to become civil engineers and in certain other branches of engineering.

EXTERIOR VIEW OF THE NEW FOUNDRY OF NÄFVEQVARNS BRUK.

The Federation of Industries of Sweden has organised an Institute for labour managers in order to instruct them in economic, social, judicial and psychological subjects, the knowledge of which has proved to be of importance when exercising leadership.

The educational background of this Institute is, in short, as follows:—(1) To give instruction upon the most important principles of organisation of work, administrative economy and planning; (2) to familiarise managers with the purport of existing labour laws; (3) to elucidate the present organisation of work and agreements between employers and trade unions; (4) to familiarise foremen with the importance of loyalty towards their employers, particularly in the democratic working life of to-day, and (5) to familiarise foremen with the means to which the modern science of work, as well as the science of applied psychology, operates in reference to efforts to increase the intensity and willingness of human endeavour.

## Present Situation

Although it hit most countries so heavily and paralysed their industries, the world depression left Sweden almost untouched. The depth of the depression was reached early in the year of 1932-33 and the recovery was relatively rapid. A long and widespread conflict in the building industry was settled at the beginning of 1934, whereupon trade in the home markets became quite animated. The consumption of building material affected other industries. The domestic consumption of iron during 1934 was greater than ever before registered, and imports of pig-iron rose from 40,000 to 80,000 tons, whilst the domestic production showed an increase of 62 per cent. compared with 1933.

The engineering industries followed by the foundry industry showed a considerable intensification, and some plants were working at full capacity during the latter part of the year This trend continued during 1935, as is shown by official records for the first three quarters of last year. The imports of pig-iron during the same period were 65,000 tons, as against 48,000 during the corresponding months in 1934.

The employment coefficient giving the percentage of employed workers of the total number of workers during the five-year period, 1926-30, was during the first three quarters of 1935 for the engineering industry 110.5, 112.5 and 114.5, and for iron and steel works 115.1, 118 and 125.4. Special statistics for foundries do not exist, as their figures are included with those groups mentioned above. During the second quarter 54 engineering factories out of 285 reported a shortage of skilled workers and the condition was about the same during the third quarter.

## Raw Material

Swedish coke pig-iron hematite commands a price of Sw. Kr. 62* per ton f.o.t. works, whilst German hematite was sold in this country at Kr. 58. This year Russian pig-iron was bought for the first time in Sweden, the total import amounting to a few thousand tons. No pronouncements have as yet been made by the foundries as to quality and reliability of chemical analysis. It was sold at Kr. 53 c.i.f. Stockholm. Dutch pig-iron was imported and sold at Kr. 50 c.i.f. Gothenburg. Indian pig-iron has also been imported to Sweden for several years and is still used at some foundries. Swedish charcoal pig-iron (Si 2.5 per cent.) has been marketed at approximately Kr. 195.

The price of cast-iron scrap has increased considerably during the past few years, and that of machinery scrap has this year been quoted at 57 to 61 kr., which is higher than the price of imported coke pig-iron. All available scrap is consumed, and a certain amount of importation has been registered.

Westphalian foundry coke, which is the most-favoured brand, has been bought at kr. 33 per ton. English coke for foundry purpose has proved to be too small as well as uneven in quality.

## Recent Technical Progress

This is characterised by a steady and carefully advancing modernisation of equipment, as well as rationalisation of foundry operations. Time studies as a base for the planning of work, working methods and price setting for piece work have been started, even by the smaller foundries, those using mass production methods showing the way.

Foundrymen are availing themselves more and more of metallography when judging material, for the elucidation of unusual phenomena, the selection of material and the adjustment of working methods. There is a growing tendency to judge castings not only from analysis, but also according to structure. They are also realising more and more the importance of melting conditions and casting temperature and the cooling rate after pouring.

THE INTERIOR OF THE NEW FOUNDRY OF NÄFVEQVARNS BRUK. IT MANUFACTURES LIGHT CASTINGS, DOES JOBBING WORK AND SPECIALISES IN ART CASTINGS. THE CONCRETE SAND BUNKERS ARE IN THE BACKGROUND AND THE HEATING APPARATUS IS SUSPENDED FROM THE ROOF. THE LIGHTING IS EXCELLENT, AS THE PICTURE WAS TAKEN IN SNOWY WEATHER.

* There are about 19.4 Sw. Kr. to a pound.

For the past few years, work has been going on in order to regulate the testing and classifying specifications for grey cast iron. This year a tentative proposal was circulated to the foundries for criticism. It is based on the application of tensile and transverse tests.

The test bars are to be of four different sizes, based upon the average cross-sectional thickness of casting represented. The thermal history of their making is to be in every possible respect the same as for the casting. The tensile test bars are to be quite short, cast to shape and machined down to an arc-shape in the middle. The smallest diameters, as cast, are to be 15, 24, 33 and 44 mm., which are machined down to 13.5, 22, 30 and 40 mm.

The transverse test-bars are to have diameters of 13.5, 22, 30 and 40 mm. They are to be cast in lengths of 250, 380, 500 and 650 mm., and tested at the following distances between supports: 200, 300, 450 and 600 mm.

The cast iron is to be classified into five grades, one of which has no tensile strength specification, the rest having rising strength figures. As the strength of cast iron depends upon the cross-sectional thickness, there is given a table showing the minimum strength figures, which a certain cast iron must show when cast as test bars of different diameters and tested according to specification.

It is a well-known fact that the difference is rather great. The tentative specification includes the values given in the next column.

A corresponding table has been evolved for the transverse test and deflection. It is expected that some of the values will be adjusted and completed after a few years, when the foundries have had an opportunity of trying out the proposed specification.

*Tensile Strength.*

| Test-bar cast to shape. | | Quality. | | | | |
|---|---|---|---|---|---|---|
| | | A. | B. | C. | D. | E. |
| As cast. | Machined to | Minimum tensile breaking strength, tons per sq. in. | | | | |
| mm. | mm. | | | | | |
| — | 13.5 | * | 14.6 | 15.2 | — | — |
| 24 | 22 | * | 12.0 | 13 | 17.4 | — |
| 33 | 30 | * | 8.8 | 11.4 | 15.2 | 19 |
| 44 | 40 | * | 7 | 9.5 | 14 | 17.6 |

* Not specified.

# The Belgian Foundry Industry in 1935

## By GUSTAV MASSON (Consulting Engineer; Past President, Belgian Foundrymen's Technical Association)

THE Belgian foundry industry has been dominated during 1935 by two events. The first, of a scientific character and which only interests the various branches of the foundry, was the Brussels International Congress. The second, of quite general influence, was the devaluation of the Belgian franc.

The Brussels Congress was undoubtedly a great success and all the technical Papers have been particularly eulogistic about it. Its success was due to the efficient organisation by the Belgian Foundrymen's Technical Association on the one hand, and on the other the scientific and technical value of the Papers presented. All the outstanding questions which are at the present time uppermost in the minds of the foundrymen were included—principally those concerning cast iron; and so the participants were able to study important Papers dealing with the electric and rotary furnaces, heat-treatments, the use of special alloyed irons, soda-ash treatment, centrifugal purification, and other aspects which would take too long to enumerate. Moreover, the account of the Congress and résumé of the Papers were carefully selected and published in THE FOUNDRY TRADES JOURNAL.

The organisation of this International Congress started at the beginning of the year and necessarily the experts who responded to the appeal of the organising committee have dealt with in their Papers questions which are at the present time prominent. That is why it is possible to say that the Brussels Conference reflects the scientific activity of the foundry industry during the past year.

### Tendency Towards Special Irons

It is pleasing to state that Belgian founders, notably those handling cast iron, are working incessantly with the object of improving their products, for they are constantly in competition with both steel castings and drop forgings, notwithstanding that the demands of the buyers are always becoming greater and more severe. The general tendency is towards special irons and irons improved either by the use of new melting methods (rotary and electric furnaces, of which latter several new installations are being contemplated) or by the addition of alloys either as special pig-iron or as ferro-alloys; or again, by appropriate treatment, the use of soda ash has been the object of numerous tests which have been crowned with success.

Mention ought to be made of the extremely useful work of the Fonds Nationals de la Recherche Scientifique (Department of Scientific Research) which has subsidised a certain number of investigations relative to the foundry, such as the behaviour of metals at elevated temperatures, and it is due to the co-operation of this body that the Belgian Foundrymen's Technical Association has been able to undertake and make good the study of the life of cast iron, the results of which unquestionably present considerable interest for foundrymen. Another outstanding feature is that practically everywhere manufacturing processes are being controlled with greater care and attention than ever before. This remark applies not only to metals (which are being studied in the chemical and mechanical laboratories of ever increasing numbers) but also all other materials used in foundries; for example, sands and the cleaning media are now the object of scientific research; finally the life-test is becoming common practice in many foundries.

MR. G. MASSON.

It is also to be reported that there is a tendency to substitute foreign special pig-irons (charcoal and cold blast) which are relatively expensive by domestic irons improved with additions of either steel or ferro-alloys; the results present some interesting features but there is still some question as to whether this practice is really advantageous and whether it is definitely impossible to replace high-grade pig-iron manufactured in small blast furnaces using high-grade ore, by artificial pig-irons. The future will indicate at what ultimate cost such economy can be secured.

### Improvement in the Industrial Situation

As to devaluation, this major operation has been already so much written about that we shall confine ourselves to stating that if the effects have been slow to show themselves there has been, towards the end of the year, a general improvement of the industrial situation: the movement towards trade improvement seems to increase; unemployment is decreasing and in general prices have a tendency to stiffen slowly. A stiffening which is only in reality comparative. The foundry industry is participating in this improvement and many works are finding themselves busier than they have been for several years.

It has been said that the present prolonged crisis is a crisis of confidence. And in this connection it is as well to recognise that during the course of last year optimism has gained several points. This applies to Belgium as well as to several neighbouring countries and it is to be hoped that this advance towards recovery of confidence may be helped by a lowering of tariff walls, which have been raised somewhat almost everywhere during the course of the last few years.

If it were not for the uncertainty in the international situation its future could be regarded with confidence. One would wish to believe that the political horizon will clear itself in a short time, and one can only wish that a prosperous time will come to those who have been able to withstand the unparalleled crisis recently experienced.

---

IN THEIR REPORT OF PROGRESS for 1935, the General Electric Company state that the application of the Grunevald process to the bright annealing of rolled steel has been considerably extended, and many furnace installations have been completed. One development of the process has been in connection with the annealing of high carbon steel without decarburisation. A modification of the process has been applied to the bright annealing of copper sheets. Nitriding furnaces have been standardised, and a range consisting of five sizes is available for the surface hardening of special steels and irons by the Nitralloy process. Attention has been given to a special furnace designed for the melting out of babbit metal from bearings for remetalling purposes. Several furnaces of this type have been made for the Indian State Railways.

# The Economic and Technical Position of the French Foundry Industry in 1935

By E. RAMAS (President of the French Foundry Technical Association), in collaboration with F. RENAUD, Foundry Engineer, Graduate of the "Ecole Supérieure de Fonderie" (Foundry Technical School)

## The Economic Position

*Introduction.*—Whilst it must be acknowledged that there was no appreciable improvement in the past year in the French foundry industry, the economic position of which has in fact become worse, the authors consider that this state of things has not been confined to France only, as all other industrial countries have more or less been in the same predicament as themselves.

*Production of Pig-iron* (for steelworks, rolling mills, forges, foundries).

As compared with the previous year, this production has been as follows:—

| | | |
|---|---|---|
| First eight months of 1934.. .. | 4,108,000 tons. | |
| „ „ „ 1935.. .. | 3,863,000 „ | |
| Number of furnaces in blast—June, 1934 | 86 | Out of 211 in existence. |
| „ „ „ —June, 1935 | 82 | |

These figures speak for themselves. They show the substantial character of the setback suffered in the production of pig-iron which, for the period here considered, has been the lowest recorded in the last three years. About the middle of the year the average output of the blast furnaces had fallen from 215 to 200 tons per 24 hours, which was responsible for increasing costs by 7 per cent.

An improvement in the production was, however, announced at the end of October but this did not extend to the phosphoric iron trade, which, as will be shown, is particularly slack.

## Production of Phosphoric Foundry Iron

First eight months of 1934: 558,000 tons. First eight months of 1935: 416,000 tons.

The 1935 output is the lowest recorded in the last four years, and producers of phosphoric foundry irons are in a particularly difficult position as, owing to the very indifferent state of the market, they are unable to change over to other grades of iron, and must, therefore, accumulate substantial stocks. Producers of hematite, on the other hand, are more favourably placed because they stand a better chance of disposing of their products to manufacturers of acid steel.

## Exports and Imports of Pig-Iron

French exports of pig-iron and spiegel have fallen off to a marked extent in the first half of the year, as is shown by the following figures:—

First seven months of 1934: 99,800 tons. First seven months of 1935: 61,000 tons.

There has also been a substantial decline in imports—34,000 tons as against 40,600 tons.

## Trade Agreements and Selling Prices of Pig-Iron

Trade agreements entered into by producers of phosphoric and hematite pig in connection with selling prices became operative in 1935, the selling prices having been fixed as follows:—Phosphoric grades: basic price, 260 frs. delivery at Longwy. Hematite grades—2.5 to 3 per cent. Mn: 350 to 360 frs. (according to districts). Hematite grades—2.5 to 3 per cent. Si: 385 to 420 frs. (according to districts).

The agreement relative to the phosphoric grades was to come to an end on June 30, but it has been kept in force ever since, and was confirmed on November 18, 1935. Although the renewal of the agreement is now the subject of controversy, it will most probably be continued for another year, which is desired by the majority of pig-iron producers and also by foundrymen themselves, because it would ensure market stability.

## Selling Prices of Castings

In this connection, the following features will prove of interest:—

*Cast iron*: Early in the year an increase of 10 frs. per 100 kg. was recorded as the result of the advance in raw pig prices.

*Other metals*: Owing to the frequent repetition of small advances experienced in the cost of raw materials, the Association of French Copper, Brass and Bronze Founders found it necessary to increase selling prices by at least 0.50 fr. per kilogram.

MR. E. RAMAS.

## The General Economic Position of the Foundry Trade

The average production of French foundries still remains very low. According to information obtained from reliable sources, the output of the foundries represents only 35 per cent. of their full capacity and costs have thus risen to such disastrous heights that the position of a number of industrialists has become so difficult that they have had to close down.

Numerous instances could be mentioned of foundrymen who, as a result of the paucity of the orders in hand, have been compelled systematically to eliminate mechanical moulding and to engage hand moulders for the execution of a variety of very small jobs. This, of course, means a further increase in costs and makes it even more difficult than ever before to work with a reasonable margin of profit, more particularly in view of the fact that cut-throat competition among foundrymen frequently causes selling prices to drop to ridiculous levels. It will, however, be shown later that some intelligent efforts have been made with a view to bringing about an improvement in this regrettable state of affairs.

It goes without saying that the rather gloomy picture we have just drawn is meant to give an idea of the position viewed as a whole. It is not, however, altogether devoid of bright spots, as there are various branches whose activity, though still comparatively moderate, has certainly not been so seriously affected as in some of the cases just referred to.

## Specialised Branches

A number of attractive orders have been secured in certain branches, more particularly in connection with national defence requirements. Moreover the position in steel foundries seems to have improved more generally, about the end of last year, in the North of France. Altogether, those fortunate foundries, both iron and steel, which are directly or indirectly working for national defence requirements have experienced some measure of increased trade, which did not, however, last very long.

On various occasions fairly substantial orders were received in the heating-appliance trades, more particularly by manufacturers of cooking ranges, and it is reported that there are signs of comparatively greater activity in a foundry establishment which produces rolls for rolling mills in the Eastern district of France. While business still continues on a very small scale as far as house and other building requirements are concerned, various firms specialising in castings for machine tools, pumps, compressors, Diesel engines, etc., appear to have booked some good orders.

On the other hand, certain establishments which in former years used to experience a marked seasonal improvement, have hardly noticed anything of the kind in 1935, this having been particularly the case with producers of castings for agricultural machinery.

As regards non-ferrous metals, a few brass founders had occasion to book a few orders, including some placed by the City of Paris, but this proved of but moderate help to ornamental and monumental foundries which have been particularly badly hit by the all-round need for restricting all expenditure which is not strictly indispensable.

A most noteworthy fact in the period of deep depression now being experienced is that a new non-ferrous foundry (Cooperative d'Affinage et de Fonderie) has just been established in Marseilles. It is interesting to note that the sale of so-called statuary bronze is now governed by new legislation (law of March 8, 1935), which stipulates that no alloy containing less than 65 per cent. of copper can be lawfully described as "bronze." This stipulation was made because a large number of white alloy castings were being marketed as "statuary bronze."

## French Employers' Federation

MR. MAURICE OLIVIER, President of the French Foundry Owners' Federation, who was the initiator of a comprehensive scheme for the reorganisation of the industry on co-operative lines,[1] has been actively pressing his personal campaign of persuasion in the various industrial regions of France. Agreements between founders have

[1] FOUNDRY TRADE JOURNAL, January 3, 1935, detailed Mr. Olivier's scheme.

now been in force for some time, and these have made it possible to apportion orders among the various firms on the basis of turnover figures. These agreements have at last put a stop to the ridiculous competition which, in many cases, had been responsible for goods being sold at less than cost.

At its General Meeting, held on June 26 last, the French Foundry Owners' Federation gave its President, Mr. Olivier, an expression of its gratitude for his good work in promoting and carrying out the reorganisation of the industry not only on regional lines, but also by price-listing certain specialities.

In addition to the recent creation of a purchasing association, special reference must be made to the fact that several companies, as a result of various private amalgamation arrangements, have been able to reorganise and concentrate their manufacturing activities in those of their works which are best adapted to ensure more remunerative operation. An amalgamation of the Sambre-et-Meuse and Feignies steelworks and the absorption of the Seine Malleable Iron Foundries by the Thomé-Cromback steelworks bear witness to the new spirit now prevailing in the industry, whilst further evidence is afforded by the efforts which French manufacturers of heating appliances are now making to set up a trade agreement of their own.

## TECHNICAL PROGRESS

### Introduction

While the economic position of the industry is not such as to enable one to depict it with any degree of optimism, it is pleasing to report that the technical survey will certainly sound a more hopeful note. There is reason to believe that times of depression are, in some measure, conducive to research work and technical progress in all those industrial countries where the problems of greater efficiency and better quality are ever kept to the fore, and it is now proposed to show the principal directions in which the French foundry industry seems to have achieved the most outstanding degree of technical progress.

### Technical Education

The Paris Foundry High School has now completed the twelfth year of its existence, and during that period it has trained nearly 200 foundry engineering graduates, while nearly 100 *auditeurs libres*[2] have attended its courses. It is not proposed to give particulars here of the methods of tuition[3] favoured by this technical school, which is open to young men who already possess a certain amount of industrial experience and, of course, a fairly good general education. British friends have long been made familiar with it all, and the authors, feeling they may dispense with a detailed explanation of the School's activities, will merely refer to a few outstanding items of news, which appear likely to be of interest.

It was with the greatest pleasure that news was received that the Iron and Steel Institute had awarded the 1935 Bessemer Gold Medal to Mr. Albert Portevin, Professor at the Paris Foundry High School. Foundrymen in France fully appreciate that this is one of the highest international distinctions that can be bestowed upon a metallurgist, and the Paris Foundry High School rejoices that this signal honour should have been paid to France by British scientists.

Prof. Pierre Chevenard, who is well known for his dilatometers, micro-machines and also his research work in connection with complex alloys, etc., has kindly consented to add to the number of classes which he was already taking at the Foundry Technical School.

New regulations have recently been made concerning the granting of diplomas to engineering graduates of the Technical School, and these diplomas will now henceforth be conferred only upon those students who, apart from obtaining the necessary marks in the course of their studies, were already holding an engineer's official diploma issued to them by the French Government before joining the School.

The special vacation tour undertaken last Easter by undergraduates of the High School for instruction in actual practice was to the Ardennes district, famed as the cradle of the French foundry industry, and it also took them to the Basin of Longwy, which is renowned for its steelworks and highly-developed metallurgical industries, and during this trip the students were able to see many things that were entirely new to them.

The moulding problem set to the students as part of this year's final examinations referred to the production of 200 internal-combustion-engine crankcases, complete down to the smallest detail, the work including such questions as patterning, tools required, moulding, casting, metal, times, etc.

It was also with the greatest interest that the authors heard of the recent creation and opening of a British Foundry School, and they have no doubt that their friends on the other side of the Channel will soon come to feel the beneficial effects of such a foundation.

While the Paris High School affords the most advanced tuition available to neophyte foundry engineers in France, other branches are also catered for most perfectly in various training centres, such as the National School of Arts and Crafts and the Auxiliary Society for Technical Education, over which one of the authors has the honour to preside. Mention must also be made of the special Sunday courses where students may perfect their knowledge of practical moulding and foundry work, these courses being opened to engineers, departmental managers and men actually employed in workshops, though not to apprentices for whom vocational courses are available.

### Founders' Technical Association

The activities of the Founders' Technical Association have been of such a multifarious nature this year that it would be impossible to refer to them all within the compass of this article, and brief reference only will be made to a few outstanding features.

### Congresses Abroad

In addition to the usual Exchange Papers sent to the principal foundry technical associations abroad in connection with their annual congresses,[4] France very largely participated in the work of the Brussels International Congress, to which some ten Papers were presented, including two official contributions from the French Association, one dealing with "Special White Irons," by Messrs. M. Ballay and R. Chavy, and the other on "High-Pressure Cast Alloys," by Mr. C. Jenicek (the latter Paper was submitted also under the auspices of the Foundry Association of Czecho-Slovakia).

### Sessional Lectures

The following lectures were of outstanding interest:—"Aluminium Irons," by Mr. M. Ploye; "High-Pressure Foundrywork," by Mr. L. Jenicek; "Accidents in Foundrywork," by Mr. R. Roux; "A Machine for Brinell, Static Bending and Shearing Tests," by Mr. R. Guillery; and "The Pendulum Elasticity Meter," by Mr. P. Le Rolland. Other lectures were also of great interest, but reference can be made only to those dealing with entirely new or highly topical subjects, such as special irons, pressure casting, testing of cast irons, and the prevention of accidents.

### F.T.A.'s Annual Congress

This Congress is held within the framework of the Congress of Mines, Metallurgy and Applied Geology, and, as usual, its work proceeded on highly satisfactory lines, the most noteworthy questions dealt with thereat having been as follow:—

(1) *Special Irons.*—In particular, the highly-interesting Paper entitled "A Few Experiments on Austenitic Irons," contributed by a British foundryman, Mr. P. A. Russell, was greatly appreciated, and the authors desire to take this opportunity of telling the readers of THE FOUNDRY TRADE JOURNAL how very desirable it seems that this highly beneficial yearly exchange of technical Papers should be continued.

(2) *Pressure Castings.*—This method of production, which is indeed making enormous strides, is distinctly heading towards the employment of purer metals, higher pressures and lower temperatures.

(3) *The Need for Research Concerning the International Standardisation of Sand Testing.*—It goes without saying that this question (which will be further considered at the Düsseldorf World Congress) has already given rise to various discussions, and that many more will follow, and it is to be hoped that the problem will be fully elucidated as the result of this exchange of views, to which the most competent experts from the various participating countries are called upon to contribute.

(4) *German Silver Smelting.*—Recent research work has at last made it possible almost systematically to overcome many of the difficulties encountered in the smelting of alloys of this description.

(5) *Present Position in Regard to the Testing of Iron with One Small Test-Piece.*—Major P. Nicolau was good enough to remind the Congress of the present position regarding the industrial application of these tests, and illustrated his statement by practical demonstrations with the apparatus exhibited at the laboratory of the Central School of Arts and Manufactures.

### Committee Work

The twelve committees, within the limits of the means and time at their disposal, have continued to discharge their duties in a highly commendable manner, and in this survey it is proposed to refer only to the result of very important investigations conducted by the special committee for the rational organisation of the work.

This committee's report, entitled "An Inquiry into the Organisation of Work in the French Foundry Industry,"[5] first considers the replies given to a questionnaire that had been sent to all foundry proprietors who are members of the Association and of the various employers' federations. The points covered by the questionnaire came under two main headings:—(*a*) Questions of general organisation (accountancy, costs, internal organisation); and (*b*) questions relating to the organisation of work itself (graphs, time studies and time analysis).

Most answers went to show that some efficient method of costing was in operation. The results are generally within periods ranging from a fortnight to one month, per piece or per batch, and in a few establishments the figures are supplemented by graphs showing detailed production costs, output data, etc.

On the whole, however, but few foundries have really availed themselves of the methods referred to in the second heading (*b*) and accurate timing is practised in a very small number of cases only.

As a result of this investigation, the Committee responsible for the report has now devised the following plan of rational organisation:—(1)

[2] "Auditeurs Libres" are students sent to the School by foundry and trade organisations. They must attend the courses, but are not compelled to participate in the work for which marks are awarded to undergraduates.

[3] The authors take a personal part in this tuition in the capacity of professor and as a member of the School's Directorate.

[4] As regards current exchange Papers, the authors were particularly gratified to hear that the work of their colleagues Fabre and Dubois had given rise to an interesting discussion at the Sheffield Congress.

[5] Bulletin of the French Founders' Technical Association, Vol. 9, February, 1935, pp. 56–63.

Determination of the manual operations required for the execution of the mould; (2) determination of the formulæ for each of these operations; (3) measure of the symbols utilised in these formulæ (after prior determination of the optimum equipment to be used), and (4) establishment of such diagrams and graphs as will enable the results to be read rapidly.

At a later stage of the Committee's preparatory work, further questionnaires will be sent without delay to the foundries concerned, and meanwhile the whole question is also being made the subject of a public discussion in the Bulletin.

### Publications

A Committee was entrusted with the task of considering methods and suggestions for the improvement of the official year book so as to make of it a reference book containing the greatest possible sum of data useful to foundrymen. The Committee has since completed its selection of various additional features to be embodied in this publication: information concerning metallurgical equipment, moulding and patterning, tables and other data concerning specific gravities, melting temperatures, various critical points, expansion, etc., together with notes relating to the tests adopted by railway companies, War and Admiralty departments, etc., brought up to date by including the new "F.I.F.2" specifications for foundry irons, etc.

As this Annual for 1934 already contained a number of improvements as compared with the previous issue, there is no doubt that the new volume will greatly appeal to the foundry trade technicians, for whom it is intended.

### Competitions

The subjects covered by the annual competition may be divided into two distinct classes: (1) those relating to the study of phenomena occurring within the mould, and (2) those dealing with novel ideas bearing upon practical equipment, moulding and casting.

This competition, which by the way is no recent institution, is mentioned simply for the purpose of showing that it can induce work of real value, capable of leading to technical improvements in the practice of our industry. Among the Papers which have been awarded prizes, particular note may be made of the following:—(1) Investigation of a defect encountered in foundry work: "The Scaling of the White-heart Malleable Iron," by R. Collot; (2) "Circulation of the Gases in the Mould, Formation of Scabs, and their Classification," by A. Collin; (3) "The Standardisation of Medium-sized Boxes," by O. Meslage. The principle of this competition is quite sound, as it is obviously calculated to lead to practical suggestions. The authors are aware, of course, that the "Short Paper Competitions" organised by our friends of the I.B.F., though on somewhat different lines, since, as the name implies, the Papers have to be shorter than ours, have likewise given rise to a good deal of similarly useful work on the part of British technicians.

### Brief Summary of Recent Technical Progress in the French Foundry Industry

In view of the opening remarks bearing upon the economic position of the industry in France, it will be appreciated that there can be no question of newly-established foundry concerns, planned on a grandiose scale and equipped with the most up-to-date plant. In fact, as far as allowed by the rather limited resources now at their command, foundries have concentrated their efforts upon the improvement of such details as would enable them to obtain better-quality products. Unquestionably from personal knowledge, which is confirmed by other evidence, this aim has been satisfactorily achieved in the manufacture of rolls, among which products high-grade rolls have never been in greater demand than at the present time. As it is impossible, of course, to have an exact knowledge of what goes on in all foundries, the authors must be content with giving a few specific instances from which readers may be able to form a general idea of the technique actually favoured. In the first place, it is undeniable that, the crisis notwithstanding, the use of special irons and alloy steels of all descriptions is being widely developed in foundry work, and that, on the other hand, increased favour is being shown for heat-treatments regulated so as to ensure characteristics formerly unhoped for in foundry products (as is particularly the case with martensitic irons, whether suitable for machining or not, and nitrided irons for parts subjected to wear).

The lectures given this year to the Association by Mr. Dumas on "The Progress of Aluminium Smelting," by Mr. Lecoeuvre on "The Manufacture of Cast-Steel Cylinders for Locomotives," and by Mr. Henon on "The Regulation of Cupola Furnaces," bear striking testimony to the advances made in certain spheres of the industry, but considerations of space prevent a full description of these interesting subjects.

The large railway systems of France have now increased the period of guarantee imposed in respect of manganese-steel points and crossings from two to three years, and made it compulsory for the tensile test-pieces to be taken from the castings themselves. Although these conditions of acceptance are considerably more severe than formerly, French makers of steel castings have been able to comply therewith in consideration for an advance in price equal to 10 per cent. only. The railway companies are thus able to get an increased life of 33 per cent. on most favourable terms, more particularly if due consideration is given to the substantial saving in track-laying costs.

In spite of the present crisis, several steelworks are now installing electric furnaces for the production of quality casting steels, and among those mention may be made of the "Aciéries Nantaises," at whose works two electric furnaces, *i.e.*, one of 3-ton capacity, basic lined, and one of 1½ tons, designed by the Compagnie Electro-Mécanique, have been installed, while the "Blanc-Misseron" Steel Works also erected an electric furnace a few months ago.

It is, moreover, reported that certain French engineering firms which had hitherto preferred to import iron castings for their Diesel engines from abroad are now obtaining thorough satisfaction with parts supplied by good foundries established in France.

In conclusion, in France, as elsewhere, new uses for cast iron are being developed fairly rapidly if one considers that the effects of the world crisis are still being acutely felt, and particular mention must be made of cast-iron road paving, with which experiments are still being pursued.

This general survey of the French foundry industry in 1935, from both the economic and the technical viewpoints, is necessarily incomplete, and the reader's indulgence is craved. It would nevertheless afford the authors considerable pleasure if their remarks have been such as to give those of the readers of THE FOUNDRY TRADE JOURNAL who are interested some idea, however imperfect, of the present position of French industry. Finally, they would emphasise the fact that no feeling of discouragement is at all noticeable among French foundrymen, and that, pending the trade revival which is so much hoped for, the industry is making every effort to adapt itself to unfavourable economic conditions, while never ceasing to evince the liveliest anxiety, in difficult circumstances, to do everything in its power to promote and ensure the achievement of continued technical progress.

# Irish Free State's Largest Foundry

BY DAVID FRAME

It seems a little futile to write of the foundry industry of the Irish Free State, as, apart from the author's foundry, there are but two others in Dublin, two in Cork, one in Waterford, one in Limerick, one in Dundalk, one in Sligo, and one situated in Drogheda. Moreover, as the Hammond Lane Foundry is the only one of any size in the Dominion, employing as it does more workers than all the others put together, the following notes have been confined to the work of this concern.

The Hammond Lane Foundry Company, Limited, was purchased by the author as a going concern in 1902, having been originally established as far back as 1780. In 1906 a limited company was formed, and four years later the continued development necessitated larger facilities for manufacture, and the present premises were then obtained, covering an area of over six acres.

The company was the pioneer of manufacturers of light castings in Ireland, and has progressed considerably in this end of the business during the past 30 years. Further progress in the last two years made further extension necessary, and a new moulding shop of 40,000 sq. ft. was erected, and is now working to full capacity. The employment figures of the various departments total close upon 800 workers.

### Moulding and Melting Plant

An up-to-date melting plant, consisting of two No. 8 Jackman's cupolas, each blown by a 56-h.p. Keith-Blackman fan, has been installed, as the existing cupolas were being hard pushed to keep up to a melt of 40 tons per day. A large charging stage serves the new cupolas, the raw materials being lifted by means of electric hoists specially designed for the purpose by Morris, of Loughborough.

Modern moulding machines are being used for articles of mass-production nature, but as the home market is, to a certain extent, limited, constant changes of patterns and plant preclude a complete adaption to machine moulding. The jobbing floor is well equipped. A 5-ton overhead gantry, mould and core-drying stoves, sand-conditioning plant and loom mill are all in this department.

The range-fitting department is a spacious and well-lighted shop; to this shop an up-to-date enamelling plant is a recent addition, and high-class work is being turned out.

Recent years have seen developments along lines other than castings, and the Hammond Lane Foundry Company, Limited, are now the leading manufacturers of galvanised hollow-ware, rain-water goods and tanks in the Irish Free State, combining with this end of the business that of coppersmiths. The copper shop is run on modern lines, and turns out articles that are indeed a credit of the firm. A special department deals with the manufacture of tar and oil drums, containers and kegs, etc., upwards of 5,000 of these articles being turned out each week.

There is another important branch of this company, their iron and machinery department. They are the largest scrap merchants in Ireland. Their turnover is over 25,000 tons per year, and they send scrap all over Europe. They have their own steamer, the "Hammond Lane," which carries about 700 tons. This steamer sails between Dublin and the Baltic ports, carries scrap and brings back pig-iron, coke and other raw materials. They also control a large factory for the production of oxygen, dissolved acetylene and other gases.

The author is chairman of this company. Mr. David Frame is a director of many other

(*Concluded in preceding column.*)

(*Concluded from column 3.*)

Irish companies, and is the founder of the only electric-lamp factory in Ireland. Mr. Thomas Buchanan, the managing director, is very well known not only in Ireland, but all over England and Scotland.

# The Position of the German Foundries in 1935

By Dr.-Ing. Th. GEILENKIRCHEN

IN a book dealing with policies to be adopted in times of crisis, a leading German economist and statistician recently drew a parallel between the four phases of the trade cycle known to economic science as depression, revival, boom and "downswing," and the classical definition of the four temperaments. He said that after the boom period had reached a state of almost passionate exacerbation, the crisis suddenly plunged the confident generation into thoroughly mournful conditions; and the opinions at present expressed in trade circles in various countries would appear truly to reflect the general economic outlook, which is still distinctly depressing in certain directions, while in others there are already definite signs of recovery. Apathetic resignation has generally been overcome, and is giving way to a slightly more sanguine, if still rather sceptical, undertone.

### Political Influences

The economic life of the whole world has now reached the last-mentioned stage of gradual revival. Generally speaking, recovery set in a little earlier in Germany than was the case in the other industrial countries. Thanks to carefully-evolved schemes for creating work, it was possible, in two years' time, to reduce the number of the unemployed from rather more than 6 million to 2 million. Steps taken to combat the crisis, after their initial success, were developed into measures which reawakened the latent forces of national economy and resulted in its permanent revival. Three years have now elapsed since the first steps were taken to combat unemployment by furthering the production of motor cars and, at the same time, drawing up a comprehensive scheme for the provision of motor roads serving all parts of Germany. Simultaneously, the financing of public and private works was facilitated and the activity of the whole building industry was thereby improved; by means of State dowries, millions of young couples were assisted to set up a home of their own. All these measures not only affected the industries directly concerned, but also the subsidiary industries, and in the last resort reacted favourably upon the whole economic life of the nation. The motor-car factories and their suppliers—which latter include foundries making motor-car cylinders and pistons—are fully employed. Moreover, those industries which are engaged in producing furniture, articles for domestic use such as cast-iron stoves, household utensils of all kinds, baths and cast-iron sanitary fittings in which both the iron and steel foundry trades are greatly interested, also report the booking of satisfactory orders. The requirements of motor-car production, together with those of the furniture factories and many other industries, which in previous years had almost completely been idle, brought about an immense increase in the demand for machine tools of all descriptions, so that the orders for castings placed by engineering works likewise resulted in plenty of work for the foundries. The improvement in the building and structural engineering trades not only led to a direct increase in the demand for constructional castings, pipes and gutters, but also favoured the consumption of foundry products indirectly through the increased requirements of the roadmaking and bridgebuilding industries, and also of the engineering works producing the necessary machinery. As the result of this general economic interdependence, the employment of the individual industries concerned is approaching normal conditions, and it can be said to-day that even after the influx of orders from the authorities had diminished, the revival brought about by these orders went on of its own accord and will continue to do so in the future.

The average employment of the ironfoundries in 1935 may be taken as approximately two-thirds of the actual maximum capacity, and although the approach of winter was marked by a seasonal decrease, the future is regarded with confidence everywhere. Particularly in the sphere of pipe production, the employment of the German iron foundries was quite normal, as in addition to satisfactory sales in the home market the pipe industry was able to maintain exports at a normal level. The manufacture of pressure pipes is, however, feeling the competition of steel and asbestos cement conduit producers, both as regards price and quantity. Moreover, as a consequence of the elimination of lead as a packing medium pressure pipe manufacturers were compelled to carry out costly reconstructions, and this had an unfavourable effect upon financial results which had already been poor enough owing to low prices, the fall-pipe market in particular having been affected by keen price-cutting as a result of severe German and foreign competition.

### Export Pipe Markets

On the foreign markets, more particularly in Great Britain and America, German pipe manufacturers are faced with strong competition, while Japanese competition, which previously was keenly felt, has now become less noticeable. This may have been due, in some measure, to the heavy deliveries which Japanese manufacturers have had to effect in Manchuria, and also to the fact that Japanese supplies do not seem to have come up to the requirements of European users. Polish and Hungarian pipe manufacturers have also of late made their appearance on foreign markets, especially in the Scandinavian countries which had hitherto been regarded as Germany's unchallenged territory. The keen competition which previously existed between German down-pipe manufacturers on foreign markets has now been allayed by an intertrade agreement. There was an urgent demand for pipes of all descriptions, only very short periods being allowed for delivery, which the works were hardly able to observe. As regards road and domestic drainage castings, the turnover was higher than last year, but the prices obtained were particularly unsatisfactory.

### Sanitary Castings

Prices for sanitary castings were also rather disappointing, although the quantities sold on the home market were not altogether unsatisfactory. Sales abroad were distinctly unfavourable, because the various countries concerned have partly developed their own production and partly enforced quota restrictions. The home consumption of cast-iron baths on the whole was lower than in 1934; but in view of the increased activity in the provision of dwelling houses which has been noticeable of late, it is hoped that the capacity of the German bath industry may be more fully utilised in the near future. Following the establishment of the Cast Iron Bath Manufacturer's Association, whose membership includes all the German makers of cast-iron baths, it is expected that the price-cutting tendency in the home market will die down. Abroad, sales and prices were subjected to fluctuations in the various markets; on the whole it was possible to maintain previous export figures and even to improve upon them in certain markets, while an understanding reached by all producers interested in world trade enabled export prices to be maintained in some measure, notwithstanding present world surplus production.

### Consumers' Castings

Also in the sphere of general commercial castings, quantitative employment proved satisfactory; nevertheless, here again prices were, if anything, on the down grade. In the special branch of stove and hearth castings, the demand was less than in 1934. This may be explained mainly by the fact that owing to the mildness of the weather in the previous winter the trade still had considerable stocks in hand. The present winter has also been very mild so far, and the improvement hoped for has not yet materialised, but prices have been well maintained in this branch, and this on the whole, is also true of the export trade, in spite of a good many difficulties.

### Price Maintenance

Altogether, it may be stated that the considerable turnover improvements experienced in all branches and the resultant increase in the activity of the iron foundries have not sufficed to solve the problem of prices on such lines as would have enabled the majority of foundries to operate on a profitable basis and make adequate reserve appropriations to tide them over slack times. It is not surprising, therefore, that the members of the Association of German Iron Foundries should have, particularly during the past twelve months, made the most strenuous efforts to end the senseless cutting which is responsible for the present unsatisfactory position as regards prices, and—with the progressive restoration of German industry to more prosperous conditions—to ensure the gradual re-establishment of a sensible level of prices, satisfactory to producer and consumer alike. In order to achieve this aim, the Association of German Iron Foundries has for many years past endeavoured to persuade the works affiliated to it to adopt a reasonable method of costing. These endeavours resulted, as early as 1919, in the creation of a uniform system of costing which was propounded by the well-known Harzburg pamphlet. Yet experience has shown that the setting up of such a system was not sufficient to secure adequate selling prices for the foundries, and the interests concerned gradually recognised that it would be possible to place the foundry industry on a sound footing again only if all the foundries were compelled to quote sensible prices, based on actual costing calculations.

### Compulsory Co-operation

Evidently such a measure can be efficacious only if all the foundries supplying the home market are constrained duly to take their own costing figures into account for the calculation of their selling prices. It is therefore highly gratifying that the Ministry of German Economy, which is responsible for the welfare of the nation as a whole, should have in principle agreed to all foundries—including those which had hitherto remained outside—being organised under the Association of German Iron Foundries, and it is to be anticipated that a "cartel" for costing purposes will shortly be established on this basis, subsequently to be followed by similar organisations for malleable-iron and non-ferrous metal foundries. (The steelfoundries have been organised in the form of a cartel for some considerable time past.) This so-called costing cartel will gradually set up standard prices for all foundry products below which no individual foundry will be allowed to go unless proper costing calculations show that, owing to its special

facilities, the foundry concerned is in a position to effect delivery at lower prices. Every foundry will have to submit to thorough supervision in this respect. All works will also be compelled to keep proper books, and certain uniform accountancy and costing schemes have already been evolved.

This impending reorganisation will mean the advent in the German economic sphere of cartels of a new type, for whose goods minimum prices will be fixed on purely schematic lines, a method regarding which the public hold the view—though unjustifiably in most cases—that while such prices may reflect the requirements of the least efficient producer, they represent excessive profits for the well-equipped works. It would seem, however, that this new cartel system will best serve national interests as a whole, because the factories which—owing to better equipment, better organisation and greater ability on the part of their managers—can produce their goods at lower prices, are bound in the long run to steal a march on their competitors. The legitimate interests of the consumer will be safeguarded just as much as those of the producer, and the latter will be sure of his profit.

### Iron Foundry Competition

A price agreement on a solid foundation, however, will not alone suffice to keep a section of the national economy permanently in an efficient condition. In fact, it is just as necessary in this connection that the individual branches of industry should constantly endeavour to improve their products and adapt themselves to the higher requirements of the consuming industries. In this field, as is well known, the German ironfoundry industry has made very great efforts, especially during the post-war period. It has been possible to increase the tensile strength of cast iron from 9 to 12 tons per sq. in. to over 19 tons per sq. in., which is now attained without any difficulty. In spite of this considerable improvement, cast iron has been replaced as a structural material during the last few years to an ever-increasing degree by other materials, such as cast-steel and more particularly welded-steel constructions, as well as light metals and non-metallic materials (Bakelite and the like). The tendencies then prevailing in this field had to some extent led to a sort of dumb resignation among foundry interests, and during the last few years the opinion was repeatedly voiced that not only the founding of iron, but also that of steel were doomed as obsolescent methods of production.

### The True Value of Cast Iron

These views, however, were quickly revised. The iron foundries are now making a stand in the fight that has been forced upon them, and have in their turn assumed the offensive. Particularly as a result of the methodical research work carried out by Prof. Dr. Thum, of Darmstadt, it was found that as regards the load capacity of the individual material, what matters is not so much the absolute resistance to static stress, but rather the structural form of the finished article determined by the material and its suitability for being given various shapes, and its resistance to the constantly fluctuating dynamic stresses to which it is subjected as a structural unit. To express this conception, Prof. Thum has coined the term "Gestaltfestigkeit" (structural retentivity), which permits of judging materials and their properties in a light conforming more closely to actual facts, and he stated that as regards properties and suitability cast iron did not only closely approach wrought and cast steel, but was even superior to it in many respects. In a Paper read before this year's General Meeting of the Association of German Iron Foundries at Harzburg, Prof. Thum stated that in the case of high-speed crankshafts, as used in motor car and aero engines, made from forged, high-quality chromium nickel steel having an absolute strength of more than 63 tons per sq. in., the "fatigue resistance" dropped to approx. 31.7 tons per sq. in. on bending, and to 19 tons per sq. in. on torsion—to which shafts are constantly subjected—while owing to slight but unavoidable surface defects such crankshafts broke down in practical use when the arithmetical nominal torsional stress exceeded 4.5 to 5 tons per sq. in.

### Cast-Iron Crank Shafts

On the other hand, owing to the fact that they are much less exposed to surface defects, crankshafts made from high quality alloy cast iron, the absolute strength of which is only approx. 22 tons per sq. in., that is to say approx. one-third of that of wrought steel shafts, can be subjected to practically the same nominal torsional load. This knowledge has already been applied in practice as cast-iron crankshafts are now being used on a fairly large scale in America, England, and Germany. Besides, Prof. Thum also suggested that for other structural parts used in machinery production, high quality cast-iron should be employed to a much larger extent, while at the same time adopting considerably smaller wall thicknesses. The old idea that cast-iron construction requires a much more robust design than steel construction will accordingly have to be revised, and cast-iron will then be able to compete with light metal constructions much more extensively than has hitherto been the case.

The German iron foundries have gladly taken up these suggestions, and decided to utilise this scientific knowledge methodically. Vast possibilities are thus opened to the use of high quality cast-iron whereby this material may be able to regain in the machinery-making industry the important position from which it had gradually been displaced during the last twenty or thirty years. German iron founders are therefore entering the New Year with the hope that the prices of castings will gradually be brought back to such a level as will enable them to work at a profit, and also that the uses of cast-iron in the engineering industry will be greatly extended.

### An Invitation

During the second half of next September the German iron foundries will have the honour to welcome their foreign colleagues at the International Foundry Congress in Düsseldorf. As is customary, they will organise at the same time a special foundry exhibition which, in particular, will serve to give evidence of German foundry technique, both past and present. Leading experts in the domain of foundrywork have kindly offered to co-operate in the preparation of this exhibition, and they will spare no effort specially to illustrate the latent development of foundry technique, with reference to the production and use of castings, by the aid of theoretical and practical demonstrations. In addition, a number of Papers will deal with all aspects of foundrywork, and foreign visitors especially will have every opportunity to visit the most important foundries in the Rhenish-Westphalian district and other parts of Germany. German foundrymen will have great pleasure in showing their foreign colleagues that they feel themselves to be fellow members of one large family of founders, and that their endeavours are directed not only to the promotion of their professional work and interests, but also to the furtherance of an understanding embracing all nations.

---

*(Concluded from next column.)*

### Blotters and Desk Diaries

THE BRITISH CHILLED ROLL & ENGINEERING COMPANY, LIMITED.—A desk blotter, the top edge of which lifts up to disclose an engagement diary and a calendar.

BARROW HÆMATITE STEEL COMPANY, LIMITED.—A combined catalogue and desk diary, each page carrying a week's entries. Particularly good paper has been used, and the make-up is well set out.

## Dates and Data

We acknowledge with sincere thanks the receipt of the following diaries and calendars and heartily reciprocate the messages which accompanied them.

### Diaries

BRITISH & CONTINENTAL TRADERS, LIMITED.—A four-page-to-a-day pocket diary carrying a large section devoted to technical data and a first-class cure for snake bite.

CLAY CROSS COMPANY, LIMITED.—A five-page-to-a-day pocket diary. It now includes a picture of the new centrifugal pipemaking plant amongst its 208 pages, many of which carry useful technical data.

FRODAIR IRON & STEEL COMPANY, LIMITED.—A four-day-to-the-page pocket diary.

G. A. HARVEY & COMPANY (LONDON), LIMITED.—A week-to-the-page pocket diary containing a notebook as an inset, and much technical data.

I.C.I. METALS, LIMITED.—A small-size pocket diary containing a window for a season ticket, and a mass of technical data.

STANTON IRONWORKS COMPANY, LIMITED.—A week-to-the-page pocket diary containing 75 pages of useful data concerning pipes and cast-iron roads.

STAVELEY COAL & IRON COMPANY, LIMITED.—A week-to-the-page pocket diary carrying as an inset 73 pages of data of various kinds.

JOHN G. STEIN & COMPANY, LIMITED.—A small-size four-days-to-a-page pocket diary containing much technical data germane to the refractory industries. Several pages are devoted to first aid in accidents, but the usual snakes-bite cure has not been included! It also contains a series of well-printed maps.

STEWARTS AND LLOYDS, LIMITED.—A small-size four-pages-to-a-day pocket diary carrying 63 pages of data, mostly about steel tubes.

J. STONE & COMPANY, LIMITED.—A vest-pocket diary with four days to the page.

### Calendars

ASHWELL & NESBIT, LIMITED.—A daily tear-off wall calendar carrying a picture of a London street scene.

THE CARBORUNDUM COMPANY, LIMITED.—A monthly tear-off wall calendar carrying a really striking picture of the head of a Red Indian Chief—the trade mark of the company.

CRAVEN BROS. (MANCHESTER), LIMITED.—A tear-off wall calendar carrying three months to a page—very useful notion for many offices.

HARRISON & PEARSON, LIMITED.—A monthly tear-off calendar carrying pictures of firebricks.

H. HENDRA & SON.—A monthly tear-off wall calendar carrying a picture of a young lady in bathing kit gracefully posed against a fishing boat.

W. & J. F. JONES, LIMITED.—This monthly tear-off wall calendar carries a picture bearing the caption "The Best Yet." It is a new conception of Bubbles, and being "the best yet" will adorn the nursery wall at home.

THOMAS ROBINSON & SON, LIMITED.—A monthly tear-off wall calendar, each page carrying a different illustration of a woodworking machine.

TURBINE GEARS, LIMITED (HENRY SIMON, LIMITED).—A daily tear-off wall calendar carried out in white celluloid and over-printed with gold.

SMITH & FAWCETT, LIMITED.—A monthly tear-off wall calendar carrying pictures of their foundry and its products.

STEWARTS AND LLOYDS, LIMITED.—A monthly desk calendar carried out in white with the celluloid window relieved with gold. The case is also brightened by a small reproduction of the Union Jack.

*(Concluded on previous column.)*

# Kawaguchi—The Falkirk of Japan

By R. MAEDA (Department of Metallurgy, Tokio Imperial University)

KAWAGUCHI can be considered as a north-eastern suburb of Tokio, beyond the River Ara. It has about 40,000 inhabitants, and covers 19 sq. km. in the east centre of Kwantô Prairie. It has been a centre of the hereditary art of casting from the ancient days of Japan. During the Tokugawa Shôgunate period, many gigantic and beautiful castings for the decoration of temples and shrimes were made. These included lanterns, pots, flower-vases, bells, and occasionally coins and cannons for the Government.

When the reign of Shôgun came to an end in 1868, the cast-iron industry began to grow, and, through the stimulation of war, came to account for 90 per cent. of all cast products made in this district. From small household utensils, weighing only a few ounces, to large modern machine parts weighing about 15 tons, every variety of iron casting is now manufactured.

There are many favourable conditions for the development of the foundry industry in this district, *e.g.*, proximity to a great consuming centre of Japan (Tokio), transportation facilities by land and sea, and also abundant resources of foundry sand in the vicinity. About 400 foundry firms are standing as in a row, and nearly one-fourth of the whole population is directly or indirectly engaged by them.

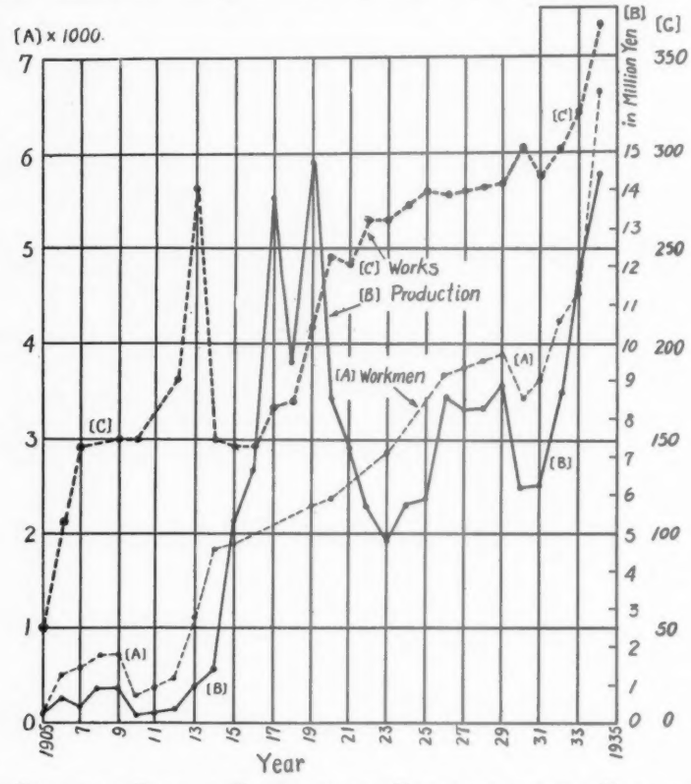



FIG. 1.—STATISTICAL GRAPH OF PRODUCTION AND EMPLOYMENT IN THE KAWAGUCHI AREA.

## Historical Notes

Two opinions are held as to the origin of the art of casting in this district. One attributes it to a Chinese master, one of the engineers invited from South China during the reign of Emperor Go-Toba (A.D. 1180), who came to Kawaguchi and taught the art during the Kamakura period (A.D. 1190-99). This opinion, however, is supported by no reliable proof.

A second opinion puts forward the view that the descendants of Temmei Kuniiye, a famous founder of the Tannan district, Kawachi, where the original Japanese art of casting—which tradition says was handed down from Ishikoridome-no-Mikoto (the Holy Ancester of Casting) from the Mythological Age of Japan—had been located, emigrated from their native place because of protracted war, and finally settled in Kawaguchi during the time of Ryakuô (A.D. 1338-42). From that time onward the art of casting in the original Japanese style was certainly handed down to the posterity. An authentic record describes how Kawaguchi, in 1764, had a street of about a quarter of a mile long, running north to south, with 14 foundries in operation, out of 314 buildings. It states that beautiful pans, pots, kettles, jars, flower vases, cooking stoves, saki-holders, etc., were being manufactured for the citizens of Yedo (former name of Tokyo).

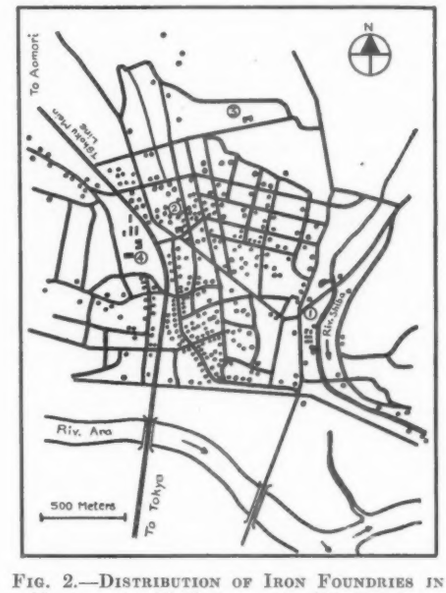



FIG. 2.—DISTRIBUTION OF IRON FOUNDRIES IN KAWAGUCHI: (1) PREFECTORIAL EXPERIMENTAL STATION; (2) OFFICE OF THE KAWAGUCHI FOUNDRY FEDERATION; (3) TOWN HALL, AND (4) IMPERIAL FUEL RESEARCH INSTITUTE.

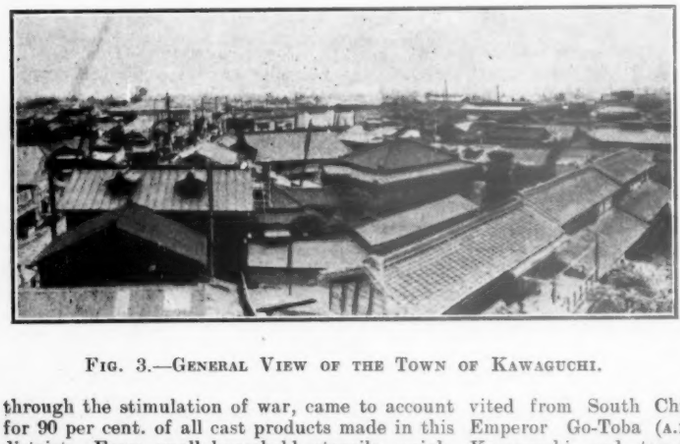


FIG. 3.—GENERAL VIEW OF THE TOWN OF KAWAGUCHI.

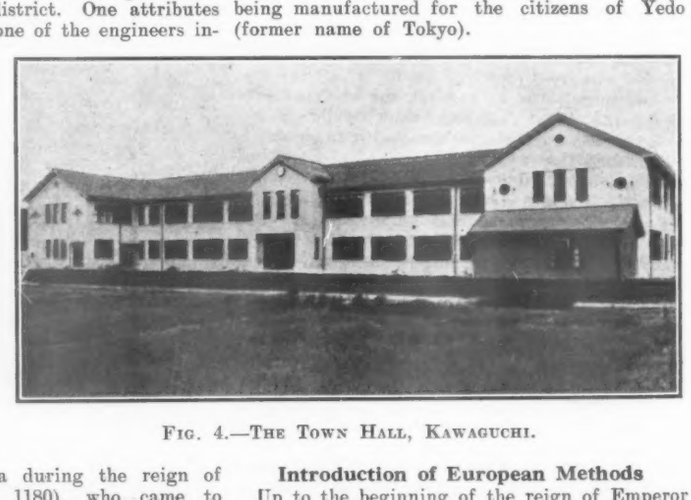


FIG. 4.—THE TOWN HALL, KAWAGUCHI.

## Introduction of European Methods

Up to the beginning of the reign of Emperor Meiji the founders in this district were generally engaged half their time in agriculture. In the first year of Meiji (A.D. 1868) sixteen works were in operation, and the establishment of new works

was strictly prohibited by local law to protect their livelihood. The foundry practice of those days was established on the Japanese method:—Japanese Yaki-Gata[1], hand-operated blowers[2], and charcoal as a fuel for the cupola were used. In the tenth year of Meiji (A.D. 1877) the European green-sand moulding method was introduced, and in the next year an attempt was made to displace Tatara by steam-engine-driven fan blowers. Motor-driven blowers were introduced in the 44th year of Meiji (A.D. 1911), whilst charcoal then was replaced by coke. A large straight cast-iron pipe for the Tokyo waterworks was manufactured in the twentieth year of Meiji (A.D. 1887).

The Sino-Japanese War (1894-95) stimulated the change of foundry practice to European style, and the production of modern machine part castings gradually increased. At that time about 200 workmen were employed. During the Russo-Japanese (1904-05) and World War (1914-19) the foundry industry of this district made rapid progress towards modernisation.

Due to the fact that the cast-iron industry of this district is composed of many small units, when the depression came a serious reduction in the number of works occurred. This was experienced during the three post-war years, and when prosperous conditions returned many works expanded their output, whilst many derelict firms were re-established.

### Foundry Owners' Organisation Formed

An organisation (the Kawaguchi Foundry Union) was formed by the owners of 67 works in 1904, and was reorganised in 1914. At that time the proprietors of engineering, enamelling, welding works and wholesale merchants were included. This organisation controls the price level, specification and inspection of a limited quantity of the local products, and has extended many fields of their market. The progress of the last thirty years is illustrated by Fig. 1, whilst the present position of the organisation in Japan is shown by the following statement. According to current official statistics the following figures as to the Kawaguchi Union are given:—

| | Works. | Workmen. |
|---|---|---|
| 1. Iron castings | 294 | 6,644 |
| 2. Steel castings | 1 | — |
| 3. Non-ferrous castings | 11 | 59 |
| 4. Machining | 62 | 1,121 |
| 5. Welding | 16 | 53 |
| 6. Plating | 7 | 51 |
| 7. Enamelling | 4 | 4 |
| 8. Wholesale dealers | 27 | — |
| 9. Kaiyu[3] | 69 | ? |

The ironfoundries account for about 70 per cent. of all industrial production in Kawaguchi each year.

About 80 per cent. (28,235) of all the population (33,977) are engaged in all industrial occupations, of which 27 per cent. (7,382) are directly associated with the foundry trades. In Fig. 2 the location of principal works is shown.

The number of independent foundries in Japan has now reached 1,500, but nowhere else are to be found features similar to this district. The total number of foundry workers now in Japan certainly amounts to over 20,000 and 37 per cent. of them are to be found here.

According to the report of a semi-official inquiry published in 1930, the smallest scale of foundry equipment can be found. It shows:—

| | |
|---|---|
| 1. Number of employees per works | 0–74 (now 150) |
| Of which 50 per cent. of the works employ between | 3–10 |
| 2. Power used per works, h.p. | 2–50 (now 180) |
| In which 90 per cent. of works, h.p. | less than 10 |
| 3. Size of cupola, in. | 13–42 |
| Average, in. | 25 |
| 4. Melting capacity per month per works, tons | 2–60 (now 100) |
| Of which 98 per cent. of works melt tons | 5–30 |
| 5. Capacity of crane, any type, per works, tons | 0–25 |

Fifty per cent. of the works are not equipped with cranes.

Moreover, 50 per cent. of all works are producing only low-grade castings from green-sand moulds. A few, however, are well equipped with modern mechanised systems and manufacture high-grade material. This extreme contrast can be noted as a characteristic feature of this district.

TABLE I.—*Dimensions and Outputs of Koshiki Furnaces.*

| Dia. in in. | Height in in. | Output in cwts. per hr. |
|---|---|---|
| 19.1 | 77.5 | 10.33 |
| 21.5 | 83.5 | 13.28 |
| 23.9 | 89.5 | 18.45 |
| 26.2 | 97.8 | 29.52 |
| 28.6 | 101.4 | 40.59 |
| 31.0 | 102.8 | 51.66 |
| 33.4 | 106.2 | 59.04 |
| 35.8 | 113.3 | 70.11 |

TABLE II.

| Position. | Sex. | Max. | Min. | Average. |
|---|---|---|---|---|
| | | Yen.* | Yen. | Yen. |
| Moulding | Men | 5.00 | 1.30 | 2.50 |
| | Women | 1.30 | 0.35 | 0.60 |
| Forging | Man only | 1.80 | 1.20 | 1.50 |
| Machining | ,, | 2.50 | 1.50 | 2.00 |
| Welding | ,, | 3.00 | 1.50 | 2.00 |
| Miscellanea | Men | 1.50 | 0.90 | 1.00 |
| | Women | 1.30 | 0.50 | 0.80 |

* A Yen = about 1*s.* 2*d.*

### Many Unique Features

It will be recognised from the above description that the foundries in this district are mostly confined to the production of domestic castings, whilst a few are well equipped and modernised. The many unique features, some of them being handed down from olden times, are detailed below.

### Small Melting Furnaces

The cupola is the actual furnace for the melting of iron. Amongst the 377 which the author examined, the smallest[4] in industrial use has an inside diameter of 9.5 in. at tuyere level. The shell is made of three segments of iron casting, and at the end of day's run it is dismantled into three separate parts, relined and mounted on a well-rammed ganister sand bed.

Obviously, to obtain uniformity in composition of molten iron with these small furnaces is not easy, but the hereditary art of melting in this district has overcome all difficulties. The dimensions and outputs of these furnaces are set-out in Table I.

### Special Melting Gang

Many of the smaller works do not melt iron every day because of the cost and possess no cupola men; thus, whenever the moulds are ready for pouring, say, every 3 to 5 days, they employ the special melters for the occasion. There are about 100 men superintended by a few masters in this occupation, generally in the ratio of one to every three or four works. This melting gang consists of three skilled men, one for tapping,[5] one for charging,[6] and the third[7] for the preparation of the raw materials. Recently many foundry owners have become alive to modern conditions, so that they are paying proper attention to the art of melting and now employ their own regular staff.

### Kaiyu

Kaiyu are molten metal buyers who not only possess no melting equipment, but also quite often no moulding shops. They are the highly-skilled men in the art of casting, and they control many workmen and apprentices. Upon the receipt of an order, usually for domestic hardware, they go to works of special type, where they prepare the moulds and buy necessary amounts of molten iron by the ladle.

There are 69 Kaiyu who employ 300 to 400 workmen and only a small number of them are recorded in the official statistics.

This unique time-honoured system can also be found in the Nambu district of this country, where the famous Nambu kettle has been manufactured from time immemorial.

TABLE III.—*Yearly Value in Yen of Castings made at Kawaguchi.**

| Year. | Machine parts. | Waterwork and gasworks. | Architectural and municipal castings. | Domestic hardware. | Miscellaneous. |
|---|---|---|---|---|---|
| 1934 | 6,852,921 | 814,410 | 1,448,283 | 3,090,552 | 2,376,494 |
| 1933 | 5,947,274 | 414,058 | 1,138,476 | 2,996,897 | 1,541,037 |
| 1932 | 2,675,227 | 915,387 | 1,211,178 | 1,961,826 | 1,891,375 |

* A Yen = about 1s. 2d.

### Materials Testing

Only a few works have installed small laboratories where hardness testing, metallographic researches and chemical analyses can be carried out. The remaining works do not yet realise the influence routine testing can exert upon the daily operations.

A Prefectorial Experimental Station has been established for three years near the bank of River Shiba. Tensile, compression, shock and hardness tests, and microscopic and chemical analyses can rapidly be performed at low charge. It is regrettable to state that owing to a general lack of buying specifications, this quite modern technical institute is still inadequately used. Sub-contracting also creates indifference. Engi-

TABLE IV.—*Typical Compositions of Japanese Castings.*

| Type. | C. | Si. | Mn. | S. | P. | Ni. | Cr. |
|---|---|---|---|---|---|---|---|
| Ingot mould, best quality | 3.31 | 1.11 | 0.88 | 0.055 | 0.108 | — | — |
| ,, ,, average quality | 3.58 | 1.32 | 0.63 | 0.088 | 0.300 | — | — |
| Lathe bed | 3.38 | 1.25 | 0.80 | 0.055 | 0.221 | 0.83 | 0.35 |
| Machine bed plate, large size | 3.55 | 1.49 | 0.84 | 0.031 | 0.307 | — | — |
| Auto. cylinder block | 3.41 | 1.45 | 0.66 | 0.056 | 0.378 | 1.11 | 0.29 |
| ,, piston | 3.51 | 1.85 | 0.92 | 0.075 | 0.358 | 0.91 | 0.22 |
| ,, piston ring | 3.58 | 2.10 | 0.55 | 0.049 | 0.440 | 0.35 | 0.25 |
| Pulley, small size | 3.55 | 2.15 | 0.47 | 0.050 | 0.470 | — | — |
| Large pipes, best quality | 3.40 | 1.08 | 1.08 | 0.062 | 0.284 | — | — |
| ,, ,, average quality | 3.69 | 1.63 | 0.61 | 0.084 | 0.354 | — | — |
| Generator casing | 3.44 | 1.85 | 0.42 | 0.090 | 0.150 | — | — |
| Chilled wheel | 3.31 | 0.75 | 0.51 | 0.063 | 0.330 | — | — |
| Railway fittings | 3.82 | 0.81 | 0.74 | 0.071 | 0.083 | — | — |
| Brake shoes | 3.35 | 0.69 | 0.17 | 0.063 | 0.414 | — | — |
| Gas stove | 3.60 | 0.85 | 0.42 | 0.090 | 0.150 | — | — |
| Architectural ornaments, panel, statues, grilles, etc. | 3.53 | 2.36 | 0.55 | 0.088 | 0.915 | — | — |
| Roof-tile | 3.79 | 1.65 | 0.94 | 0.077 | 0.264 | — | — |

neers from the Station have to go round to the works to give instructions on melting, moulding, machining and also scientific methods of inspection.

### Patternmaking

Practically no works possesses a pattern shop. An association called the Kawaguchi Pattern Makers' Union (70 members) has been organised

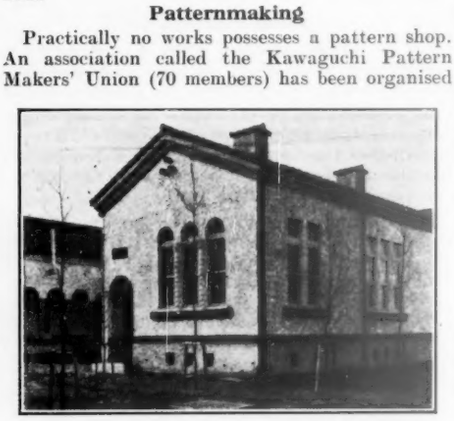


FIG. 5.—THE PREFECTORIAL EXPERIMENTAL STATION.

and under its management about 200 pattern makers are now carrying on in regular employment. They also keep many apprentices in their shops. The local patternmakers are men of experience in foundry practice, so that they usually decide the method of moulding after a glance at the blue print and they make patterns according to their own discretion. Thus, as the moulders are given no real help from them, they obey without question the proposals made by the patternmakers. In fact, many proprietors and managers or foremen are limited in their knowledge to that gained at the elementary school, and their careers may be expressed by saying "a proprietor once was an apprentice."

### Apprenticeship

There are about 100 promising apprentices of more than fourteen years of age, who have taken a six-year course at the elementary school. They are usually relatives of the staff, or workmen, of the works engaging them.

In this district, open recruitment is, in general, not carried on commensurate with the prosperous conditions. Apprentices are usually the sons of needy parents. They receive 100 to 300 Yen in advance which binds them up to the age of 21 years. When they become men of experience, the right of free selection of their occupation is bestowed on them, and some of them change their jobs. They receive, for the first time, wages according to their output. Strange to say, they do not leave their motherland to extend their knowledge, but remain in this unique district and spend their uneventful life under this hereditary system of employment.

The daily wages of the workmen are given in Table II.

TABLE V.—*Total Annual Values of Production in Yen, and average price per ton.*

| Totals. | Average price per ton. | |
|---|---|---|
| | Year. | Yen per ton. |
| 14,577,660 (93,745 tons) | 1934 | 157.2 |
| 12,037,742 (83,017 tons) | 1933 | 149.8 |
| 8,654,993 (69,429 tons) | 1932 | 124.7 |

### Production

Every variety of casting is manufactured and Table III taken from an official record shows the general situation. Table V gives the total annual values of production in yen, and the average price per ton for 1932-34.

It is interesting to note that every variety of domestic hardware, such as pots, pans, kettles, stoves, nails, ornaments, etc., is manufactured, and the increase and decrease in their production is an index of social conditions. Some typical analyses of castings are shown in Table IV.

### Prime Cost of Iron Castings

Under this heading the author cannot detail the exact level of prime cost because its calculation is not widely adopted in this district. One example, however, referring to domestic hardware is given below:—

| Items. | Yen per ton. | Per cent. |
|---|---|---|
| Raw materials— | | |
| Pig, scrap, coke, oil, sand, etc. .. .. .. | 49.1–70.0 | 51.7 |
| Pattern boxes .. .. | 0.3– 0.4 | 0.3 |
| Power, insurances and rates and taxes .. .. .. | 6.5– 9.3 | 6.9 |
| Salaries and wages .. .. | 35.8–51.1 | 37.7 |
| General stores .. .. | 3.2– 4.7 | 3.4 |
| Totals .. .. .. | 94.9–135.5 | 100.0 |

### Acknowledgments

The author expresses his sincere thanks for the help accorded to him by Mr. T. Hirano, Consulting Engineer; and The Kawaguchi Casting Union; Mr. F. Metano, Chief of Staff to The Industrial Department of The Kawaguchi Municipal Office, and to Mr. S. Suzuki, Proprietor of The S. S. Iron Foundry.

REFERENCES.

[1] Baked-sand mould in the Japanese style.
[2] A beam bellow, operated by men, called "Tatara."
[3] "Kaiyu" means molten-metal buyers. They possess no melting units. Works possessing melting facilities are called "Fukiya," which means melter's house, and the melting is called "Fuki."
[4] Small cupola, generally less than 35 in. inside dia. and made of three segments, is called "Koshiki."
[5] Called "Sen-tome," which means spout-stopper; he takes charge of the tapping of molten metal and the regulation of the blast.
[6] Called "Sumi-taki," which means fuel-burner; he is engaged in charging only.
[7] Called "Wari-ya," which means crusher, crushes and prepares pig-iron, scrap, coke, etc., to convenient size for handling.

# The Non-Ferrous Metals in 1935

## By Our Metal Exchange Correspondent

THE year just concluded was eventful in many respects, some aspects of it being of a cheering nature and others not so pleasant. On the credit side may be set the Jubilee celebrations, with their heartening uplift to general trade in this country, and the indication afforded by the steady decrease in the number of unemployed that business generally is on the up-grade. Abroad, 1935 saw a marked change-round in the trend of events in the United States, where it became increasingly evident as the months went by that at long last the tide had turned and was setting strongly towards a better state of affairs. One other favourable portent was the return of the National Government to power in this country in November and the assurance thus given that for the next four or five years we shall not be subjected to any untried financial schemes likely to upset progress.

Among the adverse factors must be cited the failure of the League to prevent the outbreak of war in Africa and the increasing state of tension in Europe as hostilities have continued. In this connection a great new experiment was put into operation—the application of sanctions against Italy. The extent of the damage thereby done to the delicate machinery of international trade cannot be accurately gauged. Throughout the past year the gold *bloc* of European countries were severely tested to maintain their standing, and currency uncertainties frequently played quite an important role on the non-ferrous metal markets. A flight from currency often means purchasing of commodities, and metals are a favourite form of this kind of exchange. The year ended on a note of much uncertainty, but a rapid change for the better is by no means impossible, and settlement of the present troubles would almost certainly bring about a brisk up-swing in trade all over the world.

### Copper Curtailment Agreement

The outstanding feature of the copper market last year was the institution of a curtailment pact among a number of the extra American producers, ensuring a reduction in the rate of output of about 20 per cent. Negotiations towards the fulfilment of this plan were already afoot before the end of 1934, but when the New Year came in the scheme was regarded with a good deal of scepticism. It was felt that there was so much divergence of opinion among the interests involved that to obtain a working agreement would be difficult to the point of impossibility. On the other hand, it was recognised that output was running at too high a level and that the price of copper was in danger of a further fall, particularly as American sales were pressing heavily on the London market. Obviously, something had to be done, but would the producers concerned be prepared to make sacrifices for the common good?

In this atmosphere the year began, with standard copper quoted at £28 7s. 6d., while electro was listed at £32, the quotation in America being 9 cents delivered Valley. As frequently happens following stocktaking, holidays, etc., the early days of January were quiet, and the market eased to £27 5s. for standard and £30 15s. for electro by the end of the month, in the absence of any definite news about the date or place of the discussions on curtailment, with a further fall in electro to £30 7s. 6d. by February 7. Throughout the month the hope of agreement on a plan of curtailment was the prop and the stay of the market, but even so, on February 25, electro broke £30 and wire bars were listed at £29 15s., with settlement standard at £26 5s. The final days, however, saw a sharp recovery, for news came through that Rhodesian delegates were to sail for New York early in March with the prospect of a meeting immediately on their arrival. Standard copper values jumped, but consumers hung back, distrusting the ability of the producers to come to grips on their problem.

The promised conference made a start, and rumour immediately began to get busy, but apart from day-to-day fluctuations the market paid little or no attention to the reports coming over from New York, although the feeling that something would be done began to gain ground. Finally, on March 29, news came through that the curtailment agreement had actually been signed, the turnover in the standard market that day being about 5,000 tons at the midday session, while for the week some 21,000 tons were done. Prices appreciated rapidly, and on April 1 standard stood at £30 15s., while electrolytic was quoted at £34 10s. The terms of the agreement provided for a cut of 240,000 short tons in the rate of output current on January 1, the cut to take effect from June 1 and to exclude Canada

and the United States, the former, however, agreeing to co-operate in her sales policy, while limits were placed on exports from the United States. The change in sentiment brought about by the signing of the pact was very marked and the turnover in standard copper leapt up to five figures as speculators came in strongly in the expectation of higher prices later in the year.

Electro moved ahead rapidly in line with the changed face of the warrant market, reaching £35 on April 4 and £36 five days later, standard being £31 15s. settlement, and around this level consumers who had been holding off made up their minds to come in, sales on the Continent and in this country being on a large scale, with the United States rather a reluctant seller. May saw the rise continued, electro reaching £36 10s. on the 7th and £1 higher a bare week later, with standard at £33 15s., but speculators went on buying, for electro was talked up to £40, and manufacturers, after standing aloof following their initial buying movement, began to buy again. Stocks in official warehouses had meanwhile been mounting up and had reached 80,000 tons. The rise culminated on May 27 with electro at £38 10s. and standard at £34 17s. 6d., and then came a dramatic crash following on the declaration in the United States of the illegality of the N.R.A. code system. In London the warrant market went mad, and 30,000 tons of standard were sold in the last week of May. June was a black period for copper, and by the end of that month standard was back at £29 and electro at £33, while, to crown all, the domestic price in New York was cut to 8 cents. July, however, brought a change for the better, with speculators buying again on news that consumers in the United States were helping themselves at the lower level, and electro recovered sharply to £36 5s. by the middle of the month on rumours of some announcement by producers in conference in London, but a reaction followed.

### Steady Progress towards End of Year

August saw the beginning of what was to prove a healthy upward trend in copper values based on a steadily-improving statistical position. The smooth working of the curtailment scheme was the chief cause of the rally, but in the initial stages consumers on this side were very reluctant buyers, although in the United States the reverse was the case, and the domestic price advanced to 8½ cents, while electro reached £37 15s. on August 26. On September 16 the American quotation advanced to 9 cents following very heavy buying, and electro in London advanced to £39 with standard at £34 12s. 6d., while the outbreak of hostilities between Italy and Abyssinia brought heavy buying in the United States in October, and in mid-month the domestic price was raised to 9¼ cents. Just prior to this, on October 11, copper quotations in London reached a high record for the year to date of £41 10s. for electro and £36 12s. 6d. for standard, although actually warrants changed hands at as high as £37. This gain in values was not, however, maintained, and the market slipped back below £40, while standard settled down on a fluctuating basis between £35 and £36, dealers awaiting some buying movement by consumers. Rumours of an increase in production were circulated, but the report was denied, and prospects of a major setback in value are remote.

### Stringency of Tin Stocks

If all other markets fail to provide entertainment, one turns to tin, and is rarely disappointed, for of all the non-ferrous metals this is the most spectacular and dangerous. In this respect the past year was no exception, for we saw the final round in the fight between the international tin control and the London Metal Exchange, a struggle which, as a matter of fact, has not yet been concluded. An outstanding feature of the year was the persistent decline of stocks in the United Kingdom, for from 4,250 tons in official warehouses at January 31 there was a fall to 801 tons at the end of November. Alarmed by the shortage of prompt metal, which seriously upset dealings on the Metal Exchange, the production quota was raised in August to 65 per cent., again early in October to 70 per cent., almost immediately thereafter to 80 per cent., and in December to 90 per cent., which should bring about an increase in stocks and an adjustment of the unfortunate position in which this country has been placed. Consumption of tin during 1935 was apparently about the same as in 1934, viz., some 21,000 tons, the tinplate trade taking rather more than half that total.

The year opened with the price at £228 10s., but January proved to be a quiet month, with consumers' dealings on 'Change mainly professional. Already the scarcity of early metal was making itself felt, and on January 31 there was a backwardation of £5 per ton. February saw the price still slipping back, cash falling to £227 15s. by the middle of the month, with three months some £4 lower, but still lower prices followed, and under the shadow of trouble in the pepper market values slumped badly, while day-to-day fluctuations were very wide. The cash price touched £215 on February 26, but March saw some improvement until the announcement of an increase from 40 to 45 per cent. in the quota for the second quarter brought prices down rapidly to £208 cash and £204 10s., three months, on March 19. This increase was, however, offset by an improvement in American demand, where early in April tinplate activity was said to be running at about 95 per cent. of capacity, and in consequence the price improved to £226 10s. on May 1. A week later the backwardation was £6, and members walked out of the tin ring in protest against the artificial conditions in force, but on May 23 this had become £8, and the price was £232. Thereafter came a downward trend, but on the announcement that quotas for the third quarter would be fixed at 50 per cent. instead of 55, as had been expected, there was an improvement.

The hold-up of supplies, however, continued, and on June 20 the backwardation was £12, while a month later it was £20, with no sellers of cash at any price, this being the subject of questions in the House of Commons. As already mentioned, August saw the quota raised to 65 per cent., and the quotation came down to £209 by the middle of the month, but the tightness of the cash position brought a rise of about £10 fairly quickly, and a further rise to £226 followed. During the weeks which followed there was a gradual appreciation in the spot price and a widening of the backwardation, which in mid-October amounted to £23, cash tin being quoted at that time at £248 per ton. This was on the fourteenth of the month, and, but little more than a week later, the quotation had slumped to £217, which proved to be the limit. A recovery followed, and values recovered to within striking distance of £240 by mid-November. Again there came a setback, with a fall of some £15, the backwardation keeping at about £10, and, with business at rather a low ebb, the tendency has since been rather downwards.

### The Strength of Lead

The year opened with lead quoted at £10 5s., the market being under the influence of the investigation by the Import Duties Advisory Committee, which it was recognised would be of long duration. On January 1 bonded stocks of lead in this country amounted to 15,000 tons, but, although consumption was favourable, this reserve remained untouched, and manufacturers continued to buy Empire brands. With the influx of some speculative demand, values rose at the end of March to £12, while by mid-May they were up to £14 on good all-round buying. Cable makers, the battery trade and the building industry, where great activity prevailed, were the chief consumers. With minor fluctuations, which kept the quotation between £13 and £14, the year went on, till July saw another upward movement, and £15 was reached and passed. In August trouble broke out at the Mexican mines, and persisted for many weeks, as a result of which a shortage began to develop, and the market moved up again, reaching £16 during the second half of the month. Late September and early October saw the price advancing rapidly under the influence of strong consumptive and speculative demand, prompted by the outbreak of war, the rise going as far as £19 10s.

The exhaustive inquiry by the J.D.A. Committee led to the adoption on August 27 of a flat rate of 7s. 6d. as duty on imported foreign metal, while Empire brands were given a permitted premium of a like amount. By this means it was hoped to encourage more buying on the Metal Exchange and to overcome the consumers' objections to the premiums over the L.M.E. price which they maintained were being levied on them. Actually, things have not turned out quite as was hoped, for foreign lead has all been taken by the Continent, and we have actually re-exported from stocks in this country, as a result of which consumers have continued perforce to use Empire metal. For the strength of lead during 1935 the building boom was largely responsible, and the future course of prices depends very much on the extent to which this is maintained.

### Spelter's Low Value

In circumstances similar to those surrounding lead, spelter opened in January last at £12, being at that time, be it noted, some £2 higher than the heavier metal. The Zinc Cartel was no more, but this had been discounted, and hopes were expressed that the I.D.A. inquiry would result in a removal of the selling pressure, which had so much depressed values. March saw the price down to £11 10s., but later in the month a sharp recovery took the quotation up to £13 for a few days. April was a month of fluctuating price movements. May saw a rapid advance to £15 in sympathy with the upward movement in lead, but at the end of that month this metal was rapidly overhauling spelter, and on June 3 it surpassed it in value. This ascendency was not, however, firmly established until July, for by that time it was evident that spelter consumption was only moderately good and that there was plenty of metal to meet all demands. This, in fact, has been the bugbear for spelter all through the year, and we enter 1936 without much expectation that values can rise very far.

The revised duty on spelter was fixed at 12s. 6d. flat rate, but, as with lead, there has not been any indication that foreign producers intend to put their metal into Britain for consumption, and, since very little is purchased by manufacturers through the Metal Exchange, works are running mainly on Empire brands. Consumers have had occasion during the past year to complain about premiums, but in September the producers brought down the extra for high-grade metal from £2 10s. to £2.

---

### Metropolitan-Vickers' Employees

A general review of the employees' benefit schemes associated with Metropolitan-Vickers Electrical Company, Limited, has disclosed the striking fact that the present accumulated funds thereof total over half a million pounds. This great total has been accumulated during the last fourteen years by approximately 13,000 employees, and is made up by works and staff benevolent funds, a male staff pension and life assurance scheme, a female staff benefit scheme, and a thrift scheme which, in effect, is a savings bank open to all employees domiciled in the British Isles. The various schemes are administered by trustees and committees. Practically all the schemes are supplemented by generous contributions made by the company.

# Metallurgical Research

## EXTRACTS FROM THE ANNUAL REPORT OF THE D.S.I.R.

The annual Report* of the Department of Scientific and Industrial Research for 1934-35 which has just been issued, contains summaries of the various programmes of research of the Research Associations connected with the Department. Extracts of the reports relating to metallurgical researches are appended.

### Researches on Cast Iron

Reference was made in the previous Report (see the JOURNAL, February 14, 1935) to results achieved by the British Cast Iron Research Association in producing from coarsely-graphitic pig-irons and cast irons of high carbon content, structures yielding graphite in its finest form of division. The method, which has been covered by a British patent, consists essentially in adding to the melt a small quantity of titanium and subsequently oxidising the titanium by means of a gas such as carbon dioxide. The converse process of re-coarsening a melt rendered finely graphitic by the process is accomplished by means of hydrogen. In the ordinary way difficulties arise in adding titanium to molten iron on account of the high-melting temperature of titanium-bearing ferro-alloys and on account of the ready oxidation of titanium. These difficulties have been overcome by protecting the metal from oxidation prior to solution in the metal and by evolving a titanium ferro-alloy melting at about 1,000 deg. C.

Metallurgical investigations have been begun on the influence of copper and of molybdenum in cast iron and an important investigation has also been begun on the shrinkage and contraction of cast iron. The defects in castings arising from shrinkage and contraction present the greatest of the difficulties which now confront the founder.

An important series of tests has also been undertaken on a number of metallurgical cokes in relation to melting quality. The necessary data on melting quality are being obtained from full-scale tests involving the melting of not less than 100 tons of metal for each type of coke, and on carbon and sulphur pick-up from smaller melts in the British Cast Iron Research Association cupola with closely-controlled charges.

### Iron and Steel Industrial Research Council

The past year has seen a considerable extension of the work of the Iron and Steel Industrial Research Council which has been made possible by increased grants. Six new research committees and sub-committees have been formed, and others are contemplated dealing with various aspects of iron and steel technology.

Another new sub-committee consisting of representatives of the building and iron and steel interests, with its research activities centred at the Building Research Station, Watford, is investigating the possibilities of extending the use of blast-furnace slag, particularly as a concrete aggregate. While certain air-cooled slags have been used for a long time as concrete aggregate, others—notably hematite—are unsuitable, owing to their tendency to disintegrate. A method has been devised for "foaming" such slags, and it is claimed that in all cases the final product is quite stable and suitable for use as lightweight-concrete aggregate. The resulting material is already being applied in building construction, and has proved to have a number of advantages over other building materials now in general use. Another new committee has been formed to investigate problems associated with the production and utilisation of alloy steels, many of these problems being of a fundamental nature.

* Cmd. 5013. H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. (Price 3s. net.)

### High-Purity Iron

The production of iron of high purity by the methods developed in the Metallurgy Department of the National Physical Laboratory has been continued. This high-purity iron is remarkably soft and ductile, and can be easily rolled into rod and foil. It has been found that the alpha-gamma transformation is higher than in the case of less-pure iron. The purified iron thus produced has been used in the investigation of the iron-carbon system, and in this connection it has been necessary to develop special refractories for use in melting the alloys. Although iron itself has no action on pure-alumina vessels, reduction occurs in the presence of carbon, and some aluminium passes into the metal. A method has therefore been devised for lining the crucibles with thoria, and attempts are also being made to avoid the contamination of glazed-alumina thermocouple tubes. Difficulties in obtaining suitable refractory materials for use at elevated temperatures have occurred in many other researches, and a special study of the subject has been made.

### Behaviour of Materials at High Temperatures

The research at the National Physical Laboratory on the behaviour of cast irons at high temperatures has been concluded. Data have been obtained concerning the creep and growth of five types of cast iron at temperatures up to 538 deg. C. (1,000 deg. Fah.), corresponding with the range of temperature met with in steam plant. Both growth and creep of ordinary cast iron and nickel-chromium cast iron at 538 deg. C. have been found to be reduced considerably by giving a preliminary heat-treatment at 650 deg. C., or even at 600 deg. C. Tests at 850 deg. C. have been carried out on heat-resisting irons of the high-silicon or austenitic types, whilst the rate of scaling of the whole range of irons in synthetic flue gas at 700 deg. C. has also been studied. The investigation shows that the use of cast iron in steam plant and elsewhere may well be extended, and it is anticipated that the results obtained will encourage the industries concerned to undertake further work along the lines indicated.

The investigation of the influence of the initial condition of steels on their creep properties is proceeding, and preliminary creep tests have been carried out on a carbon steel and on a carbon-molybdenum steel obtained in various conditions from the manufacturers. In the hot-rolled condition the carbon steel is somewhat inferior in creep resistance to several similar steels previously tested, whilst, after normalising, it possesses very poor creep strength. The reasons for this and similar cases of abnormal behaviour are being sought, but a further carbon steel has been obtained which, if satisfactory, will be used in conjunction with the carbon-molybdenum steel for the main programme of tests.

### Gases in Steels

The investigations into the part played by dissolved gases during the solidification of steel have been further continued. The difficulty experienced in determining the solubility of gas in molten iron, on account of the gas permeability of the refractories at high temperatures, has been overcome by the construction of a molybdenum- or tungsten-wound furnace which is totally immersed in water during the experiments. Satisfactory results have now been obtained for the solubility of hydrogen in pure iron, but the furnace design is being modified to secure still greater accuracy of results.

### Alloy Steels

A comprehensive review of published information on the properties and uses of chromium steels, including work on the effects of manganese and silicon carried out at the Research Department, Woolwich, has been published in book form by the Stationery Office. The study of alloy steels with particular reference to the properties induced by temper-hardening has been commenced by an investigation of copper-chromium steels containing up to 4 per cent. copper, together with the determination of the influence of other alloy elements on the temper-hardening characteristics of low-carbon copper steels. Work on the metallography of the iron-tantalum alloys is approaching completion. The possible utility of tantalum in steels used for nitrogen hardening, or in steels in which the properties of the carbide of tantalum may be of value, is being examined. Results of investigations on the influence of vanadium on the behaviour of carbon, nickel, chromium and nickel-chromium steels during tempering have been published.

### Oxides in Steel

Comparative work on the estimation of oxides in steels by different methods is in progress. The hot-extraction method, using high-frequency heating, has been perfected, and concordant results are now readily obtained. A description of the method, and of the results obtained on a series of steels including samples from an ingot supplied by the Ingot Committee of the Iron and Steel Institute, has been submitted for publication. The Department has co-operated with other laboratories in the examination of a series of steels supplied by the United States National Bureau of Standards. A description of the iodine method, which has been used in parallel with the hot-extraction method, has been published.

### Oxidising Power of Basic Slags

The investigation into the mechanism of the oxidising power of basic slags, which has been in progress at the Royal Technical College, Glasgow, under Prof. Hay, has been extended to include a series of investigations on furnace slags, in order to enable the behaviour of ferrites to be studied and to discover, if possible, the oxidising mechanism of the slag. The problem is being approached in a quantitative manner by determining the dissociation pressure for each constituent present in the slags and systematically building up the actual slags met with under normal working conditions. A report dealing with the binary systems $Fe_2O_3$—CaO and $Fe_2O_3$—$Fe_3O_4$ was presented at the May meeting of the Iron and Steel Institute.

### Corrosion of Metals

Work on steel by the Chemical Research Laboratory has been directed towards the design, interpretation and uses of standard corrosion tests in both stagnant and blowing salt solutions and industrial waters and a special investigation has been begun on the corrosion of locomotive-boiler tubes. Work on steel has been mainly concerned with the elucidation of (1) the invisible oxide film and interference colour films, and (2) the process of rusting in the presence of gaseous and solid impurities.

An investigation into the causes of corrosion of tar stills carried out for the Association of Tar Distillers shows that the resinoid constituents of tar are the most active agents in promoting corrosion at high temperatures. The activity of these resinoids decreases as the temperature of carbonisation of the coal rises. Ammonium chloride in entrained aqueous liquors also contributes to the corrosive properties of tars.

---

THE BURNTISLAND SHIPBUILDING COMPANY, LIMITED, Burntisland, have received an order to build a steamer of 4,400 tons deadweight from Messrs. Richard W. Jones & Company, Newport.

# WM. CUMMING & CO. LTD.

Established 1840.

**The Leading Manufacturers!**
**The Oldest Established!!**
**The Most Reliable!!!**

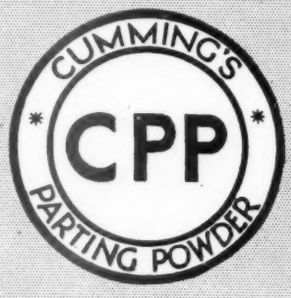
*Ironfounders' Facings Manufacturers and General Foundry Furnishers,*

**Kelvinvale Mills, Maryhill, GLASGOW**

Branches at Falkirk, Chesterfield, Deepfields and Middlesbrough

**SUPERFINE COAL DUST**

SUPERLATIVELY REGULAR IN GRIST.
SUPERIOR IN QUALITY.
SEVEN GRISTS STANDARDISED.
ONE QUALITY OF COAL THROUGHOUT.




**INGOT MOULD BLACKING**

THE BEST ON THE MARKET.
MANUFACTURED BY THE NEW PROCESS.

**BRITISH PLUMBAGOS**

AT LOW PRICES.
IMPORTED DIRECT.
NO CONTINENTAL ADULTERATION.

**POWDERED CORE GUM**

BRITISH MANUFACTURE.
BEST QUALITY.

**CUMMING FURNACE**

USERS OF THE NEW "CUMMING" FURNACE ARE INCREASING WEEK BY WEEK.

**CORE COMPOUNDS, PARTINGS, CUMMINGSTONE, REQUISITES, BLACKINGS for every PURPOSE**

ALL OUR OWN MAKE

# Recent Developments in Refractories

## PROCESSING AND REQUIREMENTS

At a meeting of the Midland Metallurgical Societies, held recently, MR. C. E. MOORE read a Paper on "Recent Developments in Refractories." Introducing the subject, the author said that the object of the Paper was to outline generally the efforts of those engaged in the production of refractories to improve existing materials and to develop new ones. In considering development, costs must always be kept in mind. Mass-production methods might be considered as a form of development equally important, although essentially different from improvement of quality. Finally, some outline must be given of the scientific work on refractories to which many of the manufacturers' advances during recent years were indirectly due. The period covered by the Paper was roughly the last ten years.

### Importance of Dimensions

Some improvements (continued the author) originate directly and solely from the manufacturer; many are rather the result of the increased severity of the demands made by the consumer. Perhaps the most obvious difference between the firebrick of to-day and that of ten or more years ago is in respect of accuracy of size and shape. Modern furnace design often demands very small tolerances in dimensions, for example, suspended-arch blocks. In other cases higher temperatures of operation have led to more rapid slag attack on joints, which must therefore be thinner. The demand for increased accuracy of size has now reached the point when 1 or 2 per cent. is the greatest permissible variation from a given dimension.

One method of tackling this problem is to use the dry-press process of manufacture, in which bricks are shaped by pressing a slightly-moist powder into steel dies. The water content is much lower than in the case of plastic clay, hence drying shrinkage is lessened, and with it the source of size variation. Settling under the influence of its own weight and warpage during drying are also rendered less easy. The process requires expensive machinery, and harder burning is often necessary to obtain sufficient strength by uniting the particles of clay firmly together, the result of this being to produce a too-vitrified brick which spalls readily when rapidly heated or cooled. Recent work appears to have overcome this difficulty by careful attention to the grading of the powder so as to obtain the maximum density.

Another method by which size and shape have been improved is by the grinding of the finished bricks. When sizing fairly soft bricks, remarkable results can be obtained. For example, glazed bricks and slabs can be cut through without chipping the glaze, and at least one brand of insulating brick now on the market has all faces machine finished. The main improvement in size and shape, especially when considered in relation to the quantity of material involved, is to be found in the improved results obtained by the use of better controlled conditions of brick-making practice, which have been firmly established for many years. These include the production of fireclay bricks from plastic clay, both by hand extrusion machine and by press, and silica bricks by hand and by pressing.

### Composition of Refractories

Turning to the actual materials of which the brick is composed, the chief change during recent years in the case of fireclay bricks has been the growing demand for a specified and continually increased percentage of alumina. For the highest alumina contents, admixtures of bauxite or of minerals of the sillimanite type have been resorted to. An increased alumina content is often associated, other things being equal, with increased resistance to slag attack, particularly with slags high in metallic oxides. Also clays high in alumina are lower in free silica, which in two of its crystal forms, quartz and cristobalite, produce certain sudden volume changes over small temperature ranges. Fireclays sufficiently high in alumina show an increased refractoriness over those nearer in composition to the silica-alumina eutectic supposed to lie at 8 to 10 per cent. of alumina.

No significant changes in the percentage of alkali fluxes in fireclay are to be observed or expected. Demands for lower iron-oxide content of fireclay bricks have been very persistent in recent years. This has been mainly in the case of bricks exposed to the action of reducing gases on account of the disintegrating effects of deposits of carbon formed by such gases on bricks containing iron oxide. The demand for lower iron content can to some extent be met by carefully selecting the clay from the normal fireclay seams. The removal of iron compounds from fireclays other than by the hand-picking method is not yet commercially practicable. The importance of iron content is often over-stressed and insufficient attention paid to the condition, both chemical and physical, of the iron oxide actually present. A well-burnt brick, in which the iron has first been oxidised fully and has then been largely fluxed or slagged, will not often give trouble due to carbon deposition. Iron oxide is often claimed greatly to reduce refractoriness under reducing conditions, but in a well-burnt brick little harmful effect need be expected.

### Smaller Sizes Required

In recent years there has been a distinct move in the direction of smaller bricks in substitution for the large blocks previously used for the purpose of blast-furnace linings. Greater accuracy of size and shape and consequent thinner, although more numerous, joints are thus obtained, while easier methods of manufacture and burning decreases the cost of this product.

Bricks composed mainly of previously-burnt clay or grog have recently become popular in this country. Good grog bricks can show an increased resistance to load at high temperatures and an increased resistance to spalling as compared with normal firebrick. The sillimanite materials, of which there are three, have been used to produce mixtures which are finding a rapidly-widening market. Sillimanite is a mineral composed of alumina and silica present in equal molecular ratio, one molecule of alumina to one of silica. It is thus much higher in alumina than clays in which the highest ratio normally met with is the molecule of alumina to two of silica. Firebricks made of sillimanite and aluminous clay are hard, have a high melting point, and a high resistance to load, and are very resistant to slag and spalling and, if the material is properly calcined, free from volume change in use.

### Use of Alumina

Excellent refractories can be, and are being, made from aluminous materials such as bauxite and corundum and sillimanite, where such materials constitute the bulk of the mixture, but when attempts are made to improve existing clays by the addition of relatively small amounts of these materials, disappointing results have been attained, the material showing little advantage over the original clay. A totally-different class of refractory product has become of increasing importance in recent years, that comprising the various materials used as refractory heat insulators. The earliest materials of this type were the natural diatomaceous earths, consisting mainly of siliceous skeletons mixed with varying amounts of clayey impurities. Mixtures of ground diatomaceous earth and clay have since been largely used, and many of the mixtures have a combustible substance, such as cork chippings or sawdust, added during manufacture. This serves to open up the texture, giving additional porosity to the finished brick. These materials give excellent insulating properties, but are liable to shrink if exposed to temperatures above 1,100 deg. C. A different class of insulator is produced in large quantities from plastic fireclay by mixing with it certain ground combustible substances, such as coal slack, coke dust or sawdust. This aids the formation of small pores, which are a necessity if the insulating properties are to be satisfactory.

In recent years considerable developments have taken place in the compounding of various materials for use as refractory cements, patching and lining materials. Among the actual cements, fireclay still remains the most commonly-used substance. Finer grading to allow of thinner joints has to some extent been adopted. Additions of sodium silicate to clay-grog mixtures, or to clay and silica mixtures, is now very common. Such mixtures harden on drying alone, a property which can also be obtained by the use of organic colloids. Mixtures of Portland cement with chromite have proved very satisfactory in certain cases, the high refractoriness of the chromite successfully counteracting the fusibility of the cement. Patching and lining mixtures are still chiefly of the clay-silica type exemplified by the various grades of ganister. Other powdered ramming materials, such as magnesite, have also found application in electric furnaces. Here, again, texture control of the bond between the particles has been shown to be of paramount importance in producing a sound lining.

Carborundum and Siloxicon have found a largely-increased field of use in such parts as muffles, furnace-burner tubes, refractory supports, etc. They were unheard of 20 or 30 years ago. Clay-bonded carborundum is now generally reserved for uses such as kiln tiles, furnace bottoms and crucibles where neither the greatest refractoriness nor the highest thermal conductivity are required. The more severe conditions are often met with by the use of recrystallised carborundum. High thermal conductivity and great strength both result from this structure. Zirconium and Zircon (zirconium silicate) have found application where price permits, as in laboratory and special furnace work, but while Zircon yields a good non-spalling material of high refractoriness and strength, slag resistance, especially to metallic oxides, is poor.

## British Steelwork Association

At the annual general meeting of the British Steelwork Association, held at Caxton House, London, S.W., recently, Mr. H. B. Jacks was re-elected as President, and Mr. E. Boynton and Mr. A. Veitch as Vice-Presidents.

As a consequence of the affiliation of the bridge and structural steelwork industry to the British Iron and Steel Federation, certain modifications of constitution will be required to conform with the progress of the general reorganisation. To this end, negotiations are now in progress as to the best means of continuing and strengthening the co-operative work of the British Steelwork Association on propaganda and market development.

The Association was formed in 1929 as a service organisation of the trade and has achieved a notable success in promoting the welfare of the industry.

# B.A./23 FOR ANODISING

Have you ever tried to match castings with wrought work on a contract for anodised metal?

This alloy has been specially produced to meet that need.

For many years the useful effects of magnesium silicide have been known and put to good use. In B.A./23 you have all the advantages conferred by magnesium silicide, high strength on heat treatment, high corrosion resistance, a clear silver anodic film in an alloy ***which can be cast.***

**Properties and information on application to the Company —Ref: DEV.**

BA The BRITISH ALUMINIUM Co., Ltd.

*Head Office:* ADELAIDE HOUSE, KING WILLIAM STREET, LONDON, E.C.4

*Telephone:* MANSION HOUSE 5561 & 8074 (5 LINES). *Telegrams:* CRYOLITE, BILGATE, LONDON

LONDON WAREHOUSE: 25-29, Pancras Road, N.W.1 — BIRMINGHAM, 4: Lawley Street. — MANCHESTER, 3: 274, Deansgate. — LEEDS, 3: 66, Kirkstall Rd. — NEWCASTLE-ON-TYNE, 1: Milburn House. — GLASGOW, C.2: 113, West Regent St.

and at New York, Toronto, Montreal, Calcutta, Sydney and Johannesburg. F.T.J. 9.1.36

# WARNER Special PIG IRONS

- Warner C.B.R.
- and
- Low Carbon Cylinder
  (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable
  (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

**Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon**

**ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY**

**Typical Cylinder Pig Iron Specification**

| | |
|---|---|
| TOTAL CARBON | 2·70% |
| SILICON | 1·80% |
| MANGANESE | ·90% |
| SULPHUR | ·06% |
| PHOSPHORUS | ·40% |

**Typical Malleable Pig Iron Specification**

| | |
|---|---|
| TOTAL CARBON | 2·60% |
| SILICON | ·75% |
| MANGANESE | ·50% |
| SULPHUR | ·05% |
| PHOSPHORUS | ·06% |

WARNER & CO., LTD
CARGO FLEET · MIDDLESBROUGH

# This Week's News in Brief

## Trade Talk

MESSRS. WILLIAM DOXFORD & SONS, LIMITED, Sunderland, have received orders from Messrs. Morel, Limited, Cardiff, and from Messrs. William Brown, Atkinson & Company, of Hull, each for a vessel of 9,200 tons deadweight, to be equipped with Doxford opposed-piston Diesel engines.

THE NEW COMPANY through which the financial arrangements will be made in connection with the scheme, announced by the Government in November, for an extensive programme of reconstruction and improvement by the four main-line railway companies, has now been registered as the Railway Finance Corporation. The directors are Sir Josiah C. Stamp and Messrs. W. K. Whigham, C. J. Hambro, E. Holland-Martin, and K. O. Peppiatt.

AN ORDER for two steamers has been placed with Sir James Lithgow by Messrs. Furness, Withy & Company, Limited, London. It is understood that the vessels, which will be 300 ft. in length and will be fitted with triple-expansion engines supplied by Messrs. John G. Kincaid & Company, Limited, Greenock, will be built by Messrs. William Hamilton & Company, Limited, Port Glasgow. Two similar vessels have been ordered from the Furness Shipbuilding Company, Limited, Haverton Hill-on-Tees.

MESSRS. RICHARD THOMAS & COMPANY, LIMITED, distributed 18,000 cans of American beer among their workmen during Christmas week. These cans have been shipped from the United States by the American Can Company. The company state that it is possible before long they may supply English beer in Welsh tinplate. Recently the company supplied 10,000 boxes of tinplate to the American Can Company, to be made into beer cans. In the United States one large company now sells 30,000,000 beer cans per month.

ACCORDING TO OUR East Midlands correspondent, Derby foundries report a brisk trade in light castings, and Ley's Malleable Castings Company, Limited, hopes to continue at full pressure. Messrs. Stokes Castings, Limited, of Mansfield, also report improvement in trade. They have secured orders for steel, for an extension to Worksop College, and for the new Masonic Temple, Mansfield. The Staveley Coal & Iron Company, Limited, report improved business during the past year. Both sand-spun and vertically-cast pipes have been in more demand.

THE FIRST ORDINARY general meeting of Cannon Iron Foundries, Limited, was held in Birmingham recently. SIR FRANCIS H. PEPPER, J.P. (chairman of directors), who presided, said that the accounts showed profits for the year ended September 30, 1935, of £66,412, being more than £11,000 in excess of the average profits for the three years to September 30, 1934, mentioned in the offer for sale of shares. The business of the company was established in 1826 as manufacturers of cast-iron hollow-ware, chemical plant, and general iron-foundry. The manufacture of gas stoves was commenced over 40 years ago, and that branch grew steadily until it became the principal department.

THE NEW YEAR CELEBRATIONS in Falkirk have been on a more cheerful scale than for a long time past, owing to a feeling of contentment engendered by the encouraging position of affairs in the local foundries. The light-castings industry has not been so prosperous as in 1935 for many years. The prospects for this year are equally good, and iron-founders are anticipating a continuance of the brisk business which has been experienced during the past year. The satisfactory position in the light-iron foundries is indicated by the returns of employment of the Ironfounders Workers' Association, which show that at the beginning of January, 1935, there were 343 members unemployed, whilst at the end of December only 100 of the 3,000 Falkirk members were on the unemployed list, almost a record low level. Over the whole membership of the Association, totalling 7,500, only 280 were unemployed at the end of the year, as compared with 1,275 at the beginning. The returns of the Iron-fitters' Association show a similar reduction.

## New Year Honours

The New Year Honours List, announced on last week, contains the names of a number of recipients associated with the foundry and allied industries.

SIR JAMES GOMER BERRY, BT., who has been made a Baron, is a director of Messrs. Guest, Keen & Nettlefolds, Limited, Messrs. John Lysaght, Limited, and Messrs. Joseph Sankey & Sons, Limited.

MR. THOMAS BIGGART, a former secretary of the Shipbuilding and Engineering Employers' Federations, and a director of Messrs. William Cook & Sons (Glasgow), Limited, and chairman of William Cook & Sons (Sheffield), Limited, is one of the new knights.

MR. PATRICK JOSEPH HENRY HANNON, who is to be knighted, is chairman of B.S.A. Tools, Limited, and deputy-chairman of the Birmingham Small Arms Company, Limited.

MR. FRANCIS ROBERT EDWARD DAVIS, who has been made a C.B.E., is secretary of the Great Western Railway Company.

MR. JOHN FREDERICK LEAN, who has been awarded the O.B.E., is principal assistant to the general manager, Great Western Railway.

MR. FREDERICK CHARLES SHELDON, who has been awarded the M.B.E., is Senior Locomotive Running Inspector, Chief Mechanical Engineer's Department, Swindon, Great Western Railway.

## Contracts Open

**Belfast,** January 14.—Iron castings, etc., for the Town Council. The City Surveyor (Room 83), City Hall.

**Torquay,** February 3.—Iron and steel castings, for the Town Council. The Borough Engineer, Town Hall.

**Birkenhead,** January 13.—Iron castings, wrought iron, mild steel reinforcement, for the Town Council. The Borough Engineer and Surveyor, Town Hall, Birkenhead.

**Blackburn,** January 25.—Wrought iron and steel, iron castings (manhole covers, valve casings, water pipes, etc.), for the Town Council. The Borough Engineer, Town Hall, Blackburn.

**Johannesburg,** February 3.—10-ton capacity overhead electric travelling crane, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference T.Y. 5,582.)

**Johannesburg,** January 27.—Two 25-ton capacity overhead electric travelling cranes, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference T.Y. 5,579.)

**Oswestry,** January 14.—120 tons of cast-iron pipes, chiefly 18 in. and 12 in. dia. ordinary and special pipes, for the Liverpool Waterworks. The Water Engineer's Office, 55, Dale Street, Liverpool, 2. (Fee £1 1s., returnable.)

**London, W.,** January 22.—Cast-iron draw-in boxes, frames and covers; high- and low-tension concentric cables; metals (non-ferrous), for the Hammersmith Borough Council. The Chief Electrical Engineer, "Electric House," 154, Uxbridge Road, W.12.

## New Companies

*(From the Register compiled by Jordan & Sons, Limited. Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)*

**Derwent Foundry Company, Limited.**—Capital, £4,000. Directors: A. Whiteman, A. Bellaby, and G. E. Ulph, and five others.

**Cobalt Products Company, Limited,** 10, Paradise Street, Sheffield.—Capital, £100. Directors. H. Williams and Mrs. D. Williams.

**Dronfield Casting Company, Limited.**—Capital, £6,000 in £1 shares. Directors: H. B. Fletcher, The Grange, Dronfield; W. D. Jamieson.

**Faulkner & Morrogh, Limited,** 33, Clement Street, Birmingham.—Capital, £1,000. Brassfounders, etc. Directors: E. W. Smith, L. F. Morrogh, and G. W. Parsons.

## Company Reports

**Qualcast, Limited.**—Interim dividend of 5 per cent., less tax.

**Thomas Bolton & Sons, Limited.**—Interim dividend of 2½ per cent. on the ordinary shares, on account of the year ending March 31 next.


## Foundry Trade Journal

PUBLISHED WEEKLY

**Subscription Terms: 15s. per annum.**
**Foreign and Colonial: 17s. 6d. per annum.**
**All Subscriptions are payable in advance.**

**All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of**

**THE FOUNDRY TRADE JOURNAL,**
**49, WELLINGTON STREET, LONDON, W.C.2**

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).


## Personal

IF MR. S. W. ALDERDYCE will communicate with the Editor, he will receive the return of a small loan he made to a friend of his some time ago.

MR. ANDREW GRAY, general manager of the Lanarkshire Steel Company, Limited, has resigned for health reasons. He will continue to act as a director of the company.

MR. H. B. JACKS, of Birmingham, who is provincial sales manager for the British (Guest Keen Baldwin) Iron & Steel Company, Limited, has been re-elected President of the British Steelwork Association.

MR. AND MRS. JAMES BROWN, Wallace Street, Falkirk, have celebrated the 50th anniversary of their marriage. Mr. Brown, a native of Linlithgow, served as moulder with the Scottish Central Iron Company, Falkirk, for many years until he retired six years ago.

MR. J. ROXBURGH has been appointed foundry manager to Messrs. Davy Bros., Limited, of Sheffield. Mr. Roxburgh is a member of the General Council of the Institute of British Foundrymen, and is also Senior Vice-President of the Sheffield Branch of the Institute.

ON THE OCCASION of his retirement from the position of President of the Falkirk Branch of the National Union of Foundry Workers, after 15 years' tenure of office, Mr. Edward Nicol was waited on by a deputation of the members and presented with a wallet and a sum of money, in recognition of his services to the union.

MR. JAMES SHAW, of the Planet Foundry Company, Limited, Audenshaw, near Manchester, who has been appointed managing director of Allied Ironfounders, Limited, was the guest of honour at a farewell gathering organised by the management and staff of the Planet Works. Pleasant references were made by Mr. Robert Archibald, the newly-appointed general manager to the Planet Foundry Company, Limited, in his toast to Mr. Shaw's association with the company.

THE ANDERSON-GRICE COMPANY, LIMITED, Taymouth Engineering Works, Carnoustie, Scotland, have appointed Mr. C. C. Richards, A.M.I.Mech.E., 113, Hampstead Way, Golders Green, London, N.W. (Telephone: SPEedwell 2638) to represent their crane interests in London and district, and Mr. K. J. Knowles, A.M.I.Mech.E., 18A, Rowan Avenue, Whalley Range, Manchester (Telephone: CHOrlton 2465) to represent them in Manchester.

### Wills

| | |
|---|---|
| HEWITT, JOHN, of Mosley, brassfounder | £26,144 |
| WATERSTON, ROBERT, a director of the Scottish Iron & Steel Company, Limited ... ... ... ... ... | £30,763 |

## Obituary

MR. F. E. DINSHAW, the Bombay financial magnate who died recently, was a director of Tata, Limited.

MR. J. LINDSEY, who died recently, had been employed at Messrs. Taylor's Bell Foundry, Loughborough, for 42 years.

MR. JOHN DRAKE, of Bathgate, who died on January 3, was employed as a moulder, and for several years had been foreman of Messrs. Renton & Fisher, Limited, Bathgate.

MR. THOMAS DAWSON, of Station Road, Chapeltown, who died recently, had been employed at the Thorncliffe Iron Works, of Messrs. Newton Chambers & Company, for 50 years.

MR. WM. SMITH, who had been employed with the Singer Company, Clydebank, for 38 years, collapsed and died in the works. He was 64 years of age and was employed in the patternshop, from which he was to retire soon with a pension.

*By courtesy of the Watford Foundry Company Limited*

# W'BRO' RIXON'S No.3 Foundry Iron

**In the foundry illustrated above, thin-walled rain-water pipes are being produced with Rixon's W'bro' Foundry Pig Iron.**

## FLUIDITY

**The high phosphorus content of this iron ensures the fluidity necessary to secure clean, sharply-moulded light castings. The analysis is as follows:—**

| | Per cent |
|---|---|
| Silicon | 3.29 |
| Sulphur | 0.025 |
| Phosphorus | 1.65 |
| Manganese | 0.34 |
| Graphitic Carbon | 3.52 |
| Combined Carbon | 0.12 |
| Total Carbon | 3.64 |

**The Stanton Ironworks Company Limited, Near Nottingham**

# Raw Material Markets

Conditions in the iron and steel trades at the end of the year were very strong and prospects for 1936 are sound. At the present time, owing to the forward position being somewhat obscure, makers are reluctant to enter into any new commitments. Fuel costs are likely to rise still further and quotations for iron and steel will have to be adjusted in a corresponding manner. The demand for pig-iron continues to be heavy and would seem to justify the lighting of additional furnaces. Makers of semi-finished steel are still being pressed for supplies, while conditions in the finished-steel section remain favourable.

## Pig-Iron

**MIDDLESBROUGH.** — The outlook in this area for 1936 is excellent as far as business in the iron and steel markets is concerned, but should the miners of the country come to a decision to strike, trade will be badly disorganised. Current outputs are being fully taken up and forward business is being offered freely, but makers are wary of the future and are therefore refraining from committing themselves further. It is now well known that the quantity of pig-iron is insufficient to satisfy all industrial requirements. As a result, Midland manufacturers are being called upon for supplies. Export trade is at a standstill. Prices are unchanged and are more or less nominal, being based upon No. 3 Cleveland G.M.B. at 70s. per ton delivered Middlesbrough or Falkirk, 72s. on the North-East Coast and 73s. on Clydeside.

It was announced during the past week that one Middlesbrough firm has lighted up an additional blast furnace, but as this will be used for the production of special iron, the total output of East Coast hematite will be unchanged. Most makers in this area are just managing to meet their commitments, but stocks are negligible and an increased output would not be amiss. Business on forward account is offering over the whole of 1936. Prices are unaltered as yet, but further increases are expected in the near future. Quotations for No. 1 quality are 71s. per ton in the Middlesbrough area, 72s. on Tyneside, 73s. 6d. on the rest of the North-East Coast, 74s. in Scotland, 78s. 6d. in Sheffield and 84s. 6d. in Birmingham.

**LANCASHIRE.**—Seasonal quietness is reported from this area, but stocktaking operations are over in most cases, and business is expected to assume normal proportions in the near future. Steady business is expected from the machine-tool trade, the light-castings makers and heavy engineering during 1936. Quotations are maintained on very firm levels, with offers of Derbyshire, Staffordshire and Lancashire brands of No. 3 foundry iron for delivery to consumers in the Lancashire zone all on the basis of 78s. per ton, Northants at 76s. 6d., and Scottish at about 83s. Prices of hematite iron have not been altered, but an increase would not cause any surprise. For delivery equal to Manchester, East Coast material is quoted at from 80s. 6d. to 81s. per ton, and West Coast at 81s.

**MIDLANDS.**—At a meeting of the pig-iron producers last week the question of prices was under discussion, but no change was made, the Association prices delivered Birmingham and Black Country stations for common foundry iron being 72s. 6d. for Northants No. 3 and 75s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, subject to a small sliding scale rebate to large consumers. The general engineering trade continues to have improved needs in special irons. Prices are not controlled, but are firm, with expectations of further advances. Medium-phosphorus irons are on offer between 77s. 6d. and 87s. 6d., low-phosphorus from 89s. to 92s. 6d., and refined iron from £5 15s. to £7 15s. per ton delivered this area. As yet, quotations for hematite are unchanged. Heavy tonnages are being taken up, and most users are booked up as far as the manufacturers will permit. Prices, which are controlled, delivered South Staffordshire stations are £4 4s. 6d. for West Coast mixed numbers, £4 3s. 6d. for East Coast No. 3, and £4 3s. for Welsh mixed numbers. An additional 1s. 6d. per ton is charged if delivered into works in 10-ton lots.

**SCOTLAND.**—Owing to the New Year holidays trade in this district has been of little consequence, but is now improving again. Most works resumed last Monday, but in some cases there will be a longer vacation owing to repairs being carried out. Prices are unchanged, and 74s. for No. 3 foundry f.o.t. furnaces continues to be quoted, with 2s. 6d. extra for No. 1. Quotations for Cleveland iron are still 70s. f.o.t. Falkirk, and 73s. f.o.t. Glasgow, with other English foundry irons quoted at 1s. 3d. per ton below the foregoing figures. Conditions with the steelmakers are sound and well filled order-books are reported. Prices of steelmaking irons are:—Mixed numbers Scottish hematite, 73s. 6d.; mixed numbers West Coast hematite, 74s.; mixed numbers East Coast hematite, 74s.; basic, British and Indian, 70s. (less 5s. rebate), all f.o.t. steelworks in this district.

## Coke

Prices of foundry coke are again firmer. For delivery in Birmingham and district best Durham coke is now offered at between 42s. 6d. and 45s., and Welsh from 38s. 6d. to 50s. per ton. Some business has already been done at the higher prices, as users were not so well covered for coke as they were for pig-iron.

## Steel

Business in the steel market has been fully resumed following the holidays, and active conditions have again developed, says the official report of the London Iron and Steel Exchange. To some extent business is handicapped by uncertainties arising from the situation in the coal industry, and for the most part the steel manufacturers are averse to entering upon forward commitments. The market requirements of semi-finished steel continue to be in excess of supplies, and in many cases the producers have fallen into arrears with their deliveries. Although most of the important users have largely covered their forward needs, there is still a good volume of business offering. Substantial deliveries are being made to the consuming works, and some relief has been afforded to the situation by the arrival of a certain amount of Continental material. Business in the finished-steel department is somewhat irregular, as many users have satisfied their requirements for the time being. The demand for shipbuilding and constructional purposes shows no signs of slackening, in spite of the heavy quantities which have gone into consumption during the past few months.

## Scrap

Manufacturers of steel in the Cleveland area are facing a shortage of scrap, and, to make the position more difficult, their needs are becoming heavier. The price of steel scrap is, on an average, 55s. per ton. In some cases basic pig-iron is being substituted for scrap, but supplies of pig-iron are also scarce. Foundry cast-iron scrap has a heavy demand at 57s. 6d. per ton, while for machinery metal 60s. is being paid. Iron and steel scrap of all qualities continues to have a satisfactory demand on the Midland market. Efforts have been made to secure higher quotations, but, as yet, these have not materialised. Heavy steel scrap in furnace sizes is quoted at 52s. 6d., and for heavy iron and steel mixed 50s. to 51s. 3d. is being offered. Short, heavy, steel scrap as used in the foundries continues to be quoted at 60s., delivered works. Prices on the Lancashire market are very firm, with a pronounced tendency to rise. Cast-iron scrap of good machinery quality for delivery to foundries in the Lancashire area is offered from about 50s. to 55s. per ton. In the Scottish area prices are very firm. Heavy mild-steel melting scrap in furnace sizes is at 52s. 6d., while machinery cast-iron scrap in cupola sizes, pieces not exceeding 1 cwt., is firm at around 62s. 6d. to 63s. 6d. Heavy steelworks cast-iron scrap in furnace sizes is being quoted around 52s. 6d., but little business is being transacted. Light cast-iron scrap is at 47s. 6d. per ton, delivered f.o.t. consumers' works.

## Metals

**Copper.**—Conditions in the copper market during the past week have been quiet. Consumption in Europe is reported to have been well maintained. Italy has resumed buying on a good scale and moderate tonnages have been taken up by German consumers. In the United States consumption has been well maintained and the market is firm. It was expected in some quarters that the price for electro in the United States would have been advanced during the past week, but this has not been the case and it now seems to be the opinion that there is no immediate likelihood of any alteration.

Daily market prices:—

*Cash.*—Thursday, £34 18s. 9d. to £35; Friday, £34 13s. 9d. to £34 15s.; Monday, £34 16s. 3d. to £34 17s. 6d.; Tuesday, £34 8s. 9d. to £34 10s.; Wednesday, £34 13s. 9d. to £34 16s. 3d.

*Three Months.*—Thursday, £35 6s. 3d. to £35 8s. 9d.; Friday, £35 2s. 6d. to £35 3s. 9d.; Monday, £35 3s. 9d. to £35 5s.; Tuesday, £34 17s. 6d. to £34 18s. 9d.; Wednesday, £35 2s. 6d. to £35 3s. 9d.

**Tin.**—Featureless conditions have prevailed in this market recently. The United States market reports a similar state of affairs, but in both countries a firm undertone is maintained. According to the statistics issued by Mr. W. H. Gartsen (Henry Rogers, Sons & Company), the world visible supply of tin decreased in December by 1,272 tons to 12,305 tons. A decrease in the carry-over in the Straits Settlements also occurred, by 289 tons to 1,023 tons, but the carry-over at Arnhem (Holland) increased by 70 tons to 513 tons.

Metal Exchange quotations were as follow:—

*Cash.*—Thursday, £217 15s. to £218; Friday, £213 10s. to £214 10s.; Monday, £212 to £212 10s.; Tuesday, £210 10s. to £210 12s. 6d.; Wednesday, £211 10s. to £211 12s. 6d.

*Three Months.*—Thursday, £207 15s. to £208; Friday, £205 5s. to £205 10s.; Monday, £204 to £204 10s.; Tuesday, £201 17s. 6d. to £202; Wednesday, £202 10s. to £203.

**Spelter.**—Trade in this metal, which has been at a low ebb for some considerable time, continues to be featureless. It is hoped that general trade conditions, which are expected to improve during 1936, will be the cause of a revival in spelter.

Official quotations were as follow:—

*Ordinary.* — Thursday, £14 5s.; Friday, £14 3s. 9d.; Monday, £14 6s. 3d.; Tuesday, £14 5s.; Wednesday, £14 10s.

**Lead.**—Seasonal slackness has been reflected in this market, but as soon as the influence of the holidays and the annual stocktaking period have passed conditions should again become more settled. Consumption has been well maintained recently.

Day-to-day quotations:—

*Soft Foreign (Prompt).*—Thursday, £15 10s.; Friday, £15 3s. 9d.; Monday, £15 8s. 9d.; Tuesday, £15 7s. 6d.; Wednesday, £15 7s. 6d.


**SMALL ADVERTISEMENTS**
*(Continued from page 54)*

**MISCELLANEOUS**

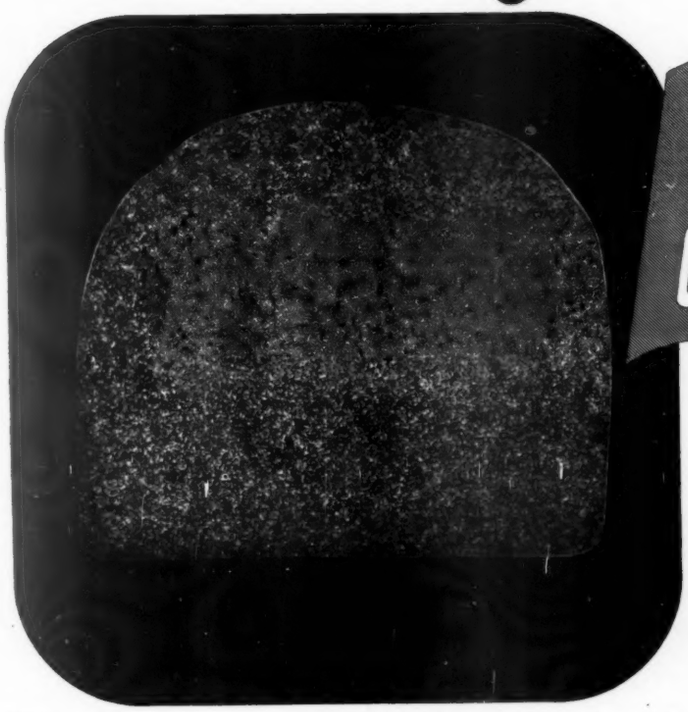
FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries. — FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

WE ARE WIREWORKERS making strong Foundry Sieves and Riddles, Fettlers' Wire Brushes of all kinds, Core-Cleaning Brushes, ½ in. to 4 in. dia., etc. Buy direct and get the right article at the right prices.—WILLIAM OLSEN, LTD., Hull.

SELECT YOUR MACHINE
FROM THE
LARGEST
STOCK OF HIGH-CLASS
SECONDHAND
MOULDING
MACHINES
IN THE WORLD
*Practical Advice Free*

THE COLEMAN FOUNDRY EQUIPMENT Co. LTD
156, STRAND, LONDON, W.C.2.

# Workington



CLOSE GRAINED

*hematite*

**FOUNDRY PIG IRON**

Foundrymen will find this special grade of iron invaluable for general work in the foundry

Workington Close-Grained Hematite Pig Iron is a special grade of iron having an ideal structure for castings which have to withstand pressure, such as valves, pumps and similar castings.

The low percentage of phosphorus allows it to be mixed with iron or scrap of higher phosphorus content to achieve a final phosphorus content in the finished casting which gives freedom from porosity and sponginess.

At the same time, as this is a hematite iron, strength and toughness are obtained with good machining qualities.

THE UNITED STEEL COMPANIES LTD

**WORKINGTON IRON AND STEEL COMPANY, WORKINGTON, CUMBERLAND**

Branch of The United Steel Companies Limited

WORKINGTON West Coast Hematite PIG IRONS

W.28

# RAW MATERIALS—PRICE LIST

(Wednesday, January 8, 1936)

## COPPER

| | £ s. d. |
|---|---|
| Standard cash | 34 13 9 |
| Three months | 35 2 6 |
| Electrolytic | 39 0 0 |
| Tough | 37 5 0 |
| Best selected | 37 15 0 |
| Sheets | 66 0 0 |
| India | 48 10 0 |
| Wire bars | 39 0 0 |
| Ingot bars | 39 0 0 |
| H.C. wire rods | 42 10 0 |
| Off. av. cash, Dec. | 35 2 8⅝ |
| Do., 3 mths., Dec. | 35 11 1⅛ |
| Do., Sttlmnt., Dec. | 35 2 9 |
| Do., Electro. Dec. | 39 11 3 |
| Do., B.S., Dec. | 38 15 10 |
| Do., wire bars, Dec. | 39 16 3 |
| Solid drawn tubes | 10½d. |
| Brazed tubes | 10½d. |
| Wire | 6½d. |

## BRASS

| | |
|---|---|
| Solid drawn tubes | 9¾d. |
| Brazed tubes | 11¼d. |
| Rods, drawn | 8¾d. |
| Rods, extd. or rlld. | 5d. |
| Sheets to 10 w.g. | 7½d. |
| Wire | 7¾d. |
| Rolled metal | 7½d. |
| Yellow metal rods | 5d. |
| Do. 4 × 4 Squares | 5¾d. |
| Do. 4 × 3 Sheets | 5¾d. |

## TIN

| | £ s. d. |
|---|---|
| Standard cash | 211 10 0 |
| Three months | 202 10 0 |
| English | 211 15 0 |
| Bars | 212 10 0 |
| Straits | 213 10 0 |
| Australian | 211 10 0 |
| Eastern | 208 10 0 |
| Banca | 212 10 0 |
| Off. av. cash, Dec. | 220 5 6¾ |
| Do., 3 mths., Dec. | 210 2 0 |
| Do., Sttlmt., Dec. | 220 3 9 |

## SPELTER

| | £ s. d. |
|---|---|
| Ordinary | 14 10 0 |
| Remelted | 13 10 0 |
| Hard | 12 5 0 |
| Electro 99.9 | 16 13 9 |
| English | 15 10 0 |
| India | 13 15 0 |
| Zinc dust | 19 10 0 |
| Zinc ashes | 4 15 0 |
| Off. aver., Dec. | 15 3 8½ |
| Aver. spot, Dec. | 15 1 9¾ |

## LEAD

| | |
|---|---|
| Soft foreign ppt. | 15 7 6 |
| Empire (nom.) | 16 2 6 |
| English | 17 10 0 |
| Off. average, Dec. | 16 16 3¾ |
| Average spot, Dec. | 16 16 0¾ |

## ALUMINIUM

| | |
|---|---|
| Ingots | £100 to £105 |
| Wire | 1/1 to 1/9 lb. |
| Sheet and foil | 1/2 to 2/9 lb. |

## ZINC SHEETS, &c.

| | |
|---|---|
| Zinc sheets, English | 22 10 0 |
| Do., V.M. ex-whse. | 24 0 0 |
| Rods | 27 15 0 |

## ANTIMONY

| | |
|---|---|
| English | 72 0 0 to 73 0 0 |
| Chinese, ex-whse. | 62 0 0 |
| Crude, c.i.f. | 32 0 0 |

## QUICKSILVER

| | |
|---|---|
| Quicksilver | 12 7 6 to 13 0 0 |

## FERRO-ALLOYS AND STEEL-MAKING METALS

| | |
|---|---|
| Ferro-silicon— | |
| 25% | 8 17 6 |
| 45/50% | 12 15 0 |
| 75% | 17 17 6 |
| Ferro-vanadium— | |
| 35/50% | 12/8 lb. Va. |
| Ferro-molybdenum— | |
| 70/75% carbon-free | 4/6 lb. Mo. |
| Ferro-titanium— | |
| 23/25% carbon-free | 9d. lb. |
| Ferro-phosphorus, 20/25% | £18 0 0 to £20 0 0 |
| Ferro-tungsten— | |
| 80/85% | 3/- lb. |
| Tungsten metal powder— | |
| 98/99% | 3/3 lb. |
| Ferro-chrome— | |
| 2/4% car. | 33 0 0 |
| 4/6% car. | 21 15 0 |
| 6/8% car. | 21 0 0 |
| 8/10% car. | 21 0 0 |
| Ferro-chrome— | |
| Max. 2% car. | 33 10 0 |
| Max. 1% car. | 36 5 0 |
| Max. 0.70% car. | 37 5 0 |
| 70% carbon-free | 9½d. lb. |
| Nickel—99.5/100% | £200 to £205 |
| "F" nickel shot | £184 0 0 |
| Ferro-cobalt, 98/99% | 5/6 lb. |
| Metallic chromium— | |
| 96/98% | 2/5 lb. |
| Ferro-manganese (net)— | |
| 76/80% loose | £10 15 0 to 11 5 0 |
| 76/80% packed | £11 15 0 to 12 5 0 |
| 76/80% export | (nom.) £9 15 0 |
| Metallic manganese— | |
| 94/96% carbon-free | 1/3 lb. |

Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL

| | |
|---|---|
| Finished bars, 14% tungsten | 2s. 0d. |
| Finished bars, 18% tungsten | 2s. 9d. |

Per lb. net, d/d buyers' works.

Extras—

| | |
|---|---|
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under ½ in. to ¼ in. | 3d. lb. |
| Do., under ¼ in. to 7/16 in. | 1/- lb. |
| Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. | 3d. lb. |
| Do., under ½ in. × ¼ in. | 1/- lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

## SCRAP

| | £ s. d. | £ s. d. |
|---|---|---|
| **South Wales—** | | |
| Heavy steel | 3 2 6 | to 3 5 0 |
| Mixed iron and steel | | 2 17 6 |
| Heavy cast iron | 2 14 0 | to 2 15 0 |
| Good machinery | 2 17 6 | to 3 0 0 |
| **Cleveland—** | | |
| Heavy steel | | 2 15 0 |
| Steel turnings | | 1 17 6 |
| Cast-iron borings | | 1 7 6 |
| Heavy cast iron | | 2 17 6 |
| Heavy machinery | | 3 0 0 |
| **Midlands—** | | |
| Light cast-iron scrap | 2 7 6 | to 2 10 0 |
| Heavy wrought iron | 3 2 6 | to 3 5 0 |
| Steel turnings | 1 17 6 | to 2 0 0 |
| **Scotland—** | | |
| Heavy steel | | 2 12 6 |
| Ordinary cast iron | | 2 17 6 |
| Engineers' turnings | | 2 0 0 |
| Cast-iron borings | 1 17 6 | to 2 0 0 |
| Wrot-iron piling | | 3 5 0 |
| Heavy machinery | 3 2 6 | to 3 3 6 |

London—Merchants' buying prices, delivered yard.

| | |
|---|---|
| Copper (clean) | 28 0 0 |
| Brass | 18 0 0 |
| Lead (less usual draft) | 13 10 0 |
| Tea lead | 9 10 0 |
| Zinc | 8 0 0 |
| New aluminium cuttings | 74 0 0 |
| Braziery copper | 25 0 0 |
| Gunmetal | 27 0 0 |
| Hollow pewter | 155 0 0 |
| Shaved black pewter | 120 0 0 |

## PIG-IRON

| | |
|---|---|
| N.E. Coast (d/d Tees-side area)— | |
| Foundry No. 1 | 72/6 |
| Foundry No. 3 | 70/- |
| ,, at Falkirk | 70/- |
| ,, at Glasgow | 73/- |
| Foundry No. 4 | 69/- |
| Forge No. 4 | 69/- |
| Hematite No. 1 | 71/- |
| Hematite M/Nos. | 70/6 |
| **N.W. Coast—** | |
| Hem. M/Nos. d/d Glas. | 74/- |
| ,, d/d Birm. | 84/6 |
| Malleable iron d/d Birm. | 115/- |
| **Midlands (d/d Birmingham dist.)—** | |
| Staffs No. 4 forge | 71/- |
| ,, No. 3 fdry. | 75/- |
| Northants forge | 68/6 |
| ,, fdry. No. 3 | 72/6 |
| ,, fdry. No. 1 | 75/6 |
| Derbyshire forge | 71/- |
| ,, fdry. No. 3 | 75/- |
| ,, fdry. No. 1 | 78/- |
| **Scotland—** | |
| Foundry No. 1, f.o.t. | 76/6 |
| ,, No. 3, f.o.t. | 74/- |
| Hem. M/Nos. d/d | 73/6 |
| **Sheffield (d/d district)—** | |
| Derby forge | 68/6 |
| ,, fdry. No. 3 | 72/6 |
| Lincs forge | 68/6 |
| ,, fdry. No. 3 | 72/6 |
| W.C. hematite | 86/- |
| **Lancashire (d/d eq. Man.)—** | |
| Derby fdry. No. 3 | 78/- |
| Staffs fdry. No. 3 | 78/- |
| Northants fdry. No. 3 | 76/6 |
| Cleveland fdry. No. 3 | 78/- |
| Dalzell. No. 3 (special) | 102/6 to 105/- |
| Glengarnock, No. 3 | 83/- |
| Clyde, No. 3 | 83/- |
| Monkland, No. 3 | 83/- |
| Summerlee, No. 3 | 83/- |
| Eglinton, No. 3 | 83/- |
| Gartsherrie, No. 3 | 83/- |
| Shotts, No. 3 | 83/- |

## FINISHED IRON AND STEEL

*Usual district deliveries for iron; delivered consumer's station for steel.*

| | £ s. d. | £ s. d. |
|---|---|---|
| **Iron—** | | |
| Bars (cr.) | 9 12 6 | to 9 15 0 |
| Nut and bolt iron | 7 17 6 | to 8 7 6 |
| Hoops | 10 10 0 | and up. |
| Marked bars (Staffs) f.o.t. | 12 0 0 | |
| Gas strip | 10 10 0 | and up. |
| Bolts and nuts, ¾ in. × 4 in. | 15 5 0 | and up. |
| **Steel—** | | |
| Plates, ship, etc. | 8 15 0 | to 8 17 6 |
| Boiler plts. | 9 5 0 | to 9 7 6 |
| Chequer plts. | 10 7 6 | |
| Angles | 8 7 6 | |
| Tees | 9 7 6 | |
| Joists | 8 15 0 | |
| Rounds and squares, 3 in. to 5½ in. | 9 7 6 | |
| Rounds under 3 in. to ¾ in. (Untested) | 8 12 0 | |
| Flats—8 in. wide and over | 8 12 6 | |
| ,, under 8 in. and over 5 in. | 8 17 6 | |
| Rails, heavy | 8 5 0 | to 8 10 0 |
| Fishplates | 12 5 0 | to 12 10 0 |
| Hoops (Staffs) | 9 7 0 | |
| Black sheets, 24g. (4-t. lots) | 11 10 0 | |
| Galv. cor. shts. ( ,, ) | 13 10 0 | |
| Galv. flat shts. ( ,, ) | 14 0 0 | |
| Galv. fencing wire, 8g. plain | 14 10 0 | |
| Billets, soft | 5 10 0 | and up. |
| Billets, hard | 6 17 6 | to 7 2 6 |
| Sheet bars | 5 10 0 | to 5 15 0 |
| Tin bars | 5 10 0 | to 5 15 0 |

## PHOSPHOR BRONZE

| | Per lb. basis. |
|---|---|
| Strip | 10½d |
| Sheet to 10 w.g. | 11½d. |
| Wire | 12½d. |
| Rods | 11½d. |
| Tubes | 14d. |
| Castings | 12½d. |

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

## NICKEL SILVER, &c.

| | Per lb. |
|---|---|
| Ingots for raising | 7d. to 1/1 |
| Rolled— | |
| To 9 in. wide | 1/1 to 1/7 |
| To 12 in. wide | 1/1½ to 1/7½ |
| To 15 in. wide | 1/1½ to 1/7½ |
| To 18 in. wide | 1/2 to 1/8 |
| To 21 in. wide | 1/2½ to 1/8½ |
| To 25 in. wide | 1/3 to 1/9 |
| Ingots for spoons and forks | 7d. to 1/3½ |
| Ingots rolled to spoon size | 10d. to 1/6½ |
| Wire round— | |
| to 10g. | 1/4½ to 1/11½ |

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

## AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2 foundry, Phila. | 21.31 |
| No. 2 foundry, Valley | 19.50 |
| No. 2 foundry, Birm. | 15.50 |
| Basic, Valley | 19.00 |
| Malleable, Valley | 19.50 |
| Grey forge, Valley | 19.00 |
| Ferro-mang. 80%, seaboard | 75.00 |
| O.-h. rails, h'y, at mill | 36.37½ |
| Billets | 29.00 |
| Sheet bars | 30.00 |
| Wire rods | 40.00 |
| | Cents. |
| Iron bars, Chicago | 1.80 |
| Steel bars | 1.85 |
| Tank plates | 1.80 |
| Beams, etc. | 1.80 |
| Skelp, grooved steel | 1.80 |
| Steel hoops | 2.10 |
| Sheets, black, No. 24 | 2.40 |
| Sheets, galv., No. 24 | 3.10 |
| Wire nails | 2.40 |
| Plain wire | 2.30 |
| Barbed wire, galv. | 2.80 |
| Tinplates, 100-lb. box | $5.25 |

## COKE (at ovens)

| | |
|---|---|
| Welsh foundry | 25/- to 30/- |
| ,, furnace | 20/- to 22/- |
| Durham foundry | 21/6 |
| ,, furnace | 19/6 |
| Scotland, foundry | 28/- |
| ,, furnace | 25/- |

## TINPLATES

f.o.b. Bristol Channel ports.

| | | |
|---|---|---|
| I.C. cokes | 20×14 per box | 18/9 to 19/- |
| ,, | 28×20 ,, | 37/6 to 38/- |
| ,, | 20×10 ,, | 27/- to 28/- |
| ,, | 18¾×14 ,, | 19/6 |
| C.W. | 20×14 ,, | 15/9 |
| ,, | 28×20 ,, | 33/9 |
| ,, | 20×10 ,, | 23/- |
| ,, | 18¾×14 ,, | 16/- |

## SWEDISH CHARCOAL IRON & STEEL

| | |
|---|---|
| Pig-iron | £6 0 0 to £7 0 0 |
| Bars-hammered, basis | £16 0 0 to £16 10 0 |
| Bars and nail-rods, rolled, basis | £15 15 0 to £16 0 0 |
| Blooms | £10 0 0 to £12 0 0 |
| Keg steel | £30 0 0 to £31 0 0 |
| Faggot steel | £18 0 0 to £23 0 0 |
| Bars and rods dead soft, st'l | £10 0 0 to £12 0 0 |

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 18.16 to £1.]

## DAILY FLUCTUATIONS

### Standard Copper (cash)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 34 18 9 dec. | 1/3 |
| ,, | 3 .. | 34 13 9 ,, | 5/- |
| ,, | 6 .. | 34 16 3 inc. | 2/6 |
| ,, | 7 .. | 34 8 9 dec. | 7/6 |
| ,, | 8 .. | 34 13 9 inc. | 5/- |

### Electrolytic Copper

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 39 5 0 No change | |
| ,, | 3 .. | 38 15 0 dec. | 10/- |
| ,, | 6 .. | 38 15 0 No change | |
| ,, | 7 .. | 38 10 0 dec. | 5/- |
| ,, | 8 .. | 39 0 0 inc. | 10/- |

### Standard Tin (cash)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 217 15 0 dec. | 5/- |
| ,, | 3 .. | 213 10 0 ,, | 85/- |
| ,, | 6 .. | 212 0 0 ,, | 30/- |
| ,, | 7 .. | 210 10 0 ,, | 30/- |
| ,, | 8 .. | 211 10 0 inc. | 20/- |

### Tin (English ingots)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 218 0 0 No change | |
| ,, | 3 .. | 214 0 0 dec. | 80/- |
| ,, | 6 .. | 212 0 0 ,, | 40/- |
| ,, | 7 .. | 210 10 0 ,, | 30/- |
| ,, | 8 .. | 211 15 0 inc. | 25/- |

### Spelter (ordinary)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 14 5 0 dec. | 6/3 |
| ,, | 3 .. | 14 3 9 ,, | 1/3 |
| ,, | 6 .. | 14 6 3 inc. | 2/6 |
| ,, | 7 .. | 14 5 0 dec. | 1/3 |
| ,, | 8 .. | 14 10 0 inc. | 5/- |

### Spelter (Electro, 99.9 per cent.)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 16 8 9 dec. | 2/6 |
| ,, | 3 .. | 16 6 3 ,, | 2/6 |
| ,, | 6 .. | 16 8 9 inc. | 2/6 |
| ,, | 7 .. | 16 8 9 No change | |
| ,, | 8 .. | 16 13 9 inc. | 5/- |

### Zinc Sheets (English)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 22 10 0 dec. | 2/6 |
| ,, | 3 .. | 22 10 0 No change | |
| ,, | 6 .. | 22 12 6 inc. | 2/6 |
| ,, | 7 .. | 22 10 0 dec. | 2/6 |
| ,, | 8 .. | 22 10 0 No change | |

### Lead (English)

| | | £ s. d. | |
|---|---|---|---|
| Jan. | 2 .. | 17 10 0 dec. | 5/- |
| ,, | 3 .. | 17 5 0 ,, | 5/- |
| ,, | 6 .. | 17 10 0 inc. | 5/- |
| ,, | 7 .. | 17 10 0 No change | |
| ,, | 8 .. | 17 10 0 ,, | ,, |

## AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS)

| Year | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Yearly average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| 1901 .. .. | 8 0 0 | 7 10 0 | 7 5 0 | 7 0 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 17 11 |
| 1902 .. .. | 7 0 0 | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 10 0 | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 10 0 | 6 10 0 | 6 13 4 |
| 1903 .. .. | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 7 0 | 6 5 0 | 6 9 4 |
| 1904 .. .. | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 10 0 | 6 5 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 2 11½ |
| 1905 .. .. | 6 5 0 | 6 5 0 | 6 0 0 | 5 17 6 | 5 15 0 | 5 15 0 | 5 15 0 | 5 15 0 | 6 0 0 | 6 5 0 | 6 15 0 | 6 15 0 | 6 1 10½ |
| 1906 .. .. | 7 0 0 | 7 5 0 | 7 5 0 | 6 17 6 | 6 15 0 | 6 12 6 | 6 10 0 | 6 10 0 | 6 10 0 | 6 12 6 | 6 16 3 | 7 3 9 | 6 17 8 |
| 1907 .. .. | 7 3 9 | 7 5 0 | 7 5 0 | 7 5 0 | 7 5 0 | 7 7 6 | 7 5 0 | 7 7 6 | 7 7 6 | 7 7 6 | 7 7 6 | 7 5 0 | 7 5 11 |
| 1908 .. .. | 7 2 6 | 7 0 0 | 7 0 0 | 7 0 0 | 6 15 0 | 6 7 6 | 6 5 0 | 6 2 6 | 6 2 6 | 6 2 6 | 6 2 6 | 6 0 0 | 6 10 0 |
| 1909 .. .. | 6 0 0 | 6 0 0 | 6 0 0 | 5 17 6 | 6 0 0 | 6 0 0 | 6 0 0 | 5 17 6 | 6 0 0 | 6 2 6 | 6 2 6 | 5 17 6 | 5 19 9½ |
| 1910 .. .. | 6 2 6 | 6 3 4½ | 6 7 6 | 6 7 6 | 6 7 6 | 6 7 6 | 6 6 6 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 7 |
| 1911 .. .. | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 10 0 | 6 12 6 | 6 16 6 | 6 7 0 |
| 1912 .. .. | 6 18 9 | 7 1 10 | 7 2 6 | 7 8 9 | 7 18 0 | 8 0 7 | 8 2 6 | 8 3 6 | 8 5 0 | 8 6 3 | 8 7 6 | 8 8 9 | 7 17 0 |
| 1913 .. .. | 8 11 6 | 8 10 7½ | 8 10 0 | 8 8 1½ | 8 2 0 | 8 0 0 | 7 17 6 | 7 11 6 | 7 8 9 | 7 5 6 | 6 18 1½ | 6 17 6 | 7 16 9 |
| 1914 .. .. | 6 17 6 | 6 15 7½ | 6 12 6 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 7 11 10½ | 8 0 0 | 7 12 6 | 7 5 7½ | 7 6 3 | 7 1 0 |
| 1915 .. .. | 7 11 6 | 8 5 11 | 8 8 9 | 9 6 0 | 10 3 2 | 10 19 2 | 11 12 6 | 11 13 1½ | 11 13 9 | 11 14 3 | 12 1 10½ | 13 0 9 | 10 6 0 |
| 1916 .. .. | 13 7 6 | 13 10 8 | 13 12 9½ | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 3 9½ |
| 1917 .. .. | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 |
| 1918 .. .. | 13 15 0 | 13 17 3 | 13 17 6 | 13 17 6 | 13 17 6 | 13 17 6 | 13 17 6 | 14 15 0 | 14 15 0 | 14 15 0 | 14 15 0 | 14 15 0 | 14 4 5½ |
| 1919 .. .. | 15 10 0 | 16 5 0 | 17 15 0 | 17 15 0 | 20 15 0 | 21 0 0 | 21 0 0 | 22 0 0 | 22 0 0 | 22 0 0 | 22 7 6 | 22 12 6 | 20 1 8 |
| 1920 .. .. | 24 7 6 | 24 10 0 | 25 10 0 | 27 10 0 | 29 5 0 | 31 0 0 | 31 10 0 | 31 10 0 | 31 10 0 | 31 10 0 | 31 10 0 | 29 7 6 | 29 1 8 |
| 1921 .. .. | 26 17 3 | 25 0 0 | 23 0 0 | 21 0 0 | 19 0 0 | 18 5 0 | 16 0 0 | 16 0 0 | 15 14 0 | 14 0 0 | 13 6 8 | 13 0 0 | 19 4 5 |
| 1922 .. .. | 13 0 0 | 12 3 9 | 11 14 0 | 11 11 10½ | 11 5 0 | 11 3 6 | 11 2 6 | 11 5 0 | 10 17 2½ | 10 16 3 | 10 13 0 | 10 12 6 | 11 7 0½ |
| 1923 .. .. | 10 16 10½ | 11 3 1½ | 12 2 6 | 12 8 9 | 12 11 6 | 12 1 3 | 11 15 11½ | 11 15 0 | 11 15 0 | 12 13 6 | 12 13 6 | 12 8 3 | 11 18 10½ |
| 1924 .. .. | 12 9 6 | 12 10 0 | 12 10 0 | 12 15 7½ | 12 17 6 | 12 17 6 | 12 17 6 | 12 17 6 | 12 17 6 | 12 14 0 | 12 12 6 | 12 12 6 | 12 14 3½ |
| 1925 .. .. | 12 12 6 | 12 12 6 | 12 12 6 | 12 12 6 | 12 12 6 | 12 7 6 | 12 7 6 | 12 7 6 | 12 4 6 | 11 18 6 | 11 13 9 | 11 13 6 | 12 6 2½ |
| 1926 .. .. | 11 7 9½ | 11 5 6 | 11 5 0 | 11 5 0 | 11 3 9 | 11 3 9 | 11 5 0 | 12 0 0 | 13 0 0 | * | 15 7 6 | 12 19 0 | 12 0 2 |
| 1927 .. .. | 12 6 3 | 12 2 6 | 11 14 0 | 11 0 0 | 10 18 9 | 10 13 6 | 10 12 6 | 10 5 0 | 9 16 0 | 9 15 0 | 9 13 9 | 9 12 9 | 10 14 2 |
| 1928 .. .. | 9 12 6 | 9 12 6 | 9 11 0 | 9 10 0 | 9 8 4 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 3 6 | 9 1 3 | 9 7 0 |
| 1929 .. .. | 9 0 0 | 9 2 6 | 9 5 7½ | 9 9 4½ | 9 10 0 | 9 17 6 | 10 2 6 | 10 2 6 | 10 2 6 | 10 0 6 | 10 3 9 | 10 5 7 | 9 15 2½ |
| 1930 .. .. | 10 7 6 | 10 7 6 | 10 7 6 | 10 6 10½ | 10 6 3 | 10 5 0 | 10 2 6 | 10 2 6 | 10 2 6 | 10 2 6 | 10 2 6 | 10 2 6 | 10 4 7½ |
| 1931 .. .. | 10 2 6 | 10 0 0 | 10 0 0 | 10 0 0 | 9 18 1½ | 9 17 6 | 9 17 6 | 9 17 6 | 9 17 6 | 9 17 6 | 9 17 6 | 9 16 10½ | 9 18 0½ |
| 1932 .. .. | 9 15 0 | 9 15 0 | 9 15 0 | 9 15 0 | 9 13 9 | 9 11 3 | 9 10 0 | 9 10 0 | 9 10 0 | 9 6 3 | 9 5 0 | 9 5 0 | 9 10 11½ |
| 1933 .. .. | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 |
| 1934 .. .. | 9 5 0 | 9 8 1½ | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 11 6 |
| 1935 .. .. | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 | 9 12 6 |

* No quotation available owing to strike.


WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

## SITUATIONS VACANT AND WANTED

FOUNDRY Engineer with 13 years' experience of lay-out, design, purchase and installation of foundry plant and equipment in largest mechanised foundries, seeks similar post.—Box 532, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

YOUNG MAN (age 27), London City and Guilds Certificate, with thorough comprehensive metallurgical experience, including laboratory work, ironfoundry practice, the heat-treatment of all grades of steel, open-hearth steelmaking, rolling-mill practice, etc., desires change as Technical Representative or similar capacity. N.E. Coast area preferred.—Write Box 524, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT in a technical bureau required. Knowledge of foundry work essential, and of languages desirable.—Apply Box 1874, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

DRESSER (Foreman) for steelfoundry specialising in medium and light-weight castings. Applicant must have good experience in the heat-treatment, dressing and welding of high-priced castings and be thoroughly acquainted with modern engineering requirements. Must have had previous control of labour and be capable of organising. Apply, stating age, salary, and full particulars, to Box 526, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVE. — Foundry pig-iron. Proved connection amongst ironfounders preferred. Salary and commission. No objection to part-time man.—Write full details, Box Z0138, c/o Deacon's, 5, St. Mary Axe, London, E.C.3.

## AGENCY

TO Malleable Founders.—Gentleman with splendid connection, engineers, shipbuilders, etc., all Scotland or part, now open to represent good firm. Full particulars; urgent.—Box 530, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

## TENDER

### ARMY CONTRACTS.

NOTICE IS HEREBY GIVEN that Tenders for goods and services of the kinds mentioned below are invited from time to time, as required :—

*Metal Trades.*

Aluminium ingot and castings, Brass, Brass rod and sheet, Bronze stampings, Copper ingot and sheet, Lead pig and sheet, Metal rod, Nickel, Pig-iron, Steel plate, rounds, sheets, etc., Tin ingot, Tinplates, Tinned-brass pressings and stampings, Zinc ingot and sheets.

Baths, Bicycles, Building materials and fitments, Cooking apparatus, Cutlery (including safety razors and blades), Enamelled ware, Forge fittings, Grates with mantels, Hollow-ware, Horse shoes, Ironmongery, Machinery, Reinforcing metal, Stable fitments, Steel and cast-iron pipes, Stoves, Tinware (including canisters, etc., to precise dimensions), Tools, Tubular scaffolding, Vehicles, Wire, Wire rope.

*Electrical, Optical and Scientific Instrument Trades.*

Cables, Electrical plant, Electrical and wireless stores, Scientific and optical instruments.

*Textile Trades.*

Blankets and rugs, Braid and lace, Canvas and canvas goods, Clothing (made up from the Department's own materials), Cotton piece goods and cotton goods, Cordage, Flannel (Union), Head-dresses, Horse rugs, Hosiery, Linen piece goods, Silk cloth and webbing and sewing silk, Towels, Woollen cloths.

(*Continued in next column.*)

## TENDER—*Continued.*

*Foodstuffs, Coal and Coke.*

*Other Trades.*

Badges and buttons, Basketware, Bedding, Boots and shoes, Brooms and brushes, Chemicals and oxygen and acetylene gases, China and earthenware, Furniture, Glazed-ware drain pipes, Harness and saddlery, Leather and leather goods, Linoleum, Medical supplies, Moulded rubber articles, Musical instruments, Oil-dressed clothing, Oils and spirits, Paints and varnishes, Refractories (firebricks, etc.), Road materials, Rubber boots and clothing, Safety glass, Sanitary appliances, Shellac, Timber, Woodware.

*Building Works, etc.*

Jobbing, painting and repair work (including term contracts), New buildings, Heating and electrical installations, Erection of constructional steelwork, Reinforced-concrete work, Road and drainage work, Roofing and flooring work, Construction of sports grounds, etc.

Firms not already on the War Office List of Tenderers, who wish to be invited to tender for the above Army requirements as they arise, should apply in writing to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1, for Form 1 (Form 1A in respect of the services mentioned under Building Works above), on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods or carry out services for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have employed or purchased from them and are in a position to certify as to the quality of their work. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on February 16, 1926 :—

"That, in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment to the fullest possible extent of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

*Sales.*

From time to time the Department has for sale surplus Army Stores of various descriptions, among which may be mentioned Boots, Clothing, Electrical and wireless stores, Explosives and chemicals (including drugs, ammonium nitrate and sodium picrate), Hutting, Machinery, Medical and dental stores, Motor vehicles and spare parts, Optical and scientific instruments, Scrap metals, Textile goods, Veterinary stores.

Firms who wish to be invited to tender for the purchase of surplus stores should apply in writing to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1.

Sales of surplus stores by auction are also held at the Royal Arsenal, Woolwich, about the middle of January, March, May, July, September and November. Catalogues may be obtained from the Chief Ordnance Officer, Royal Arsenal, Woolwich, S.E.18.

No application is necessary from firms whose names are already on the War Office Lists, unless they have extended the range of their manufactures.

F. C. BOVENSCHEN,
Director of Army Contracts.

## MACHINERY

FOR SALE, Blacksmiths' Hearths, complete with Tuyeres; sizes 3′ x 3′; £5 each.—Apply E. Hind, Imperial Works, South Bank/Tees.

## MACHINERY—*Continued*

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. Davies & Son, West Gorton, Manchester.

Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.

Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.

All complete with Air Compressors, etc.

Pneulec Royer Sand Thrower, size No. 1.

Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.

Three Mumford Yoke Headpress Pneumatic Moulding Machines.

Two Herbert Whizzer Sand Disintegrators.

Two Brealey Type ditto.

Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.

Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.

500 Electric Motors, Dynamos, Rotary Converters, etc.

**S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.**
**CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.**
**'Phone: Broadwell 1359.**

**THOS. W. WARD LTD.**

Two Pneumatic Jar-ram MOULDING MACHINES (Pneu. Eng. Co.); table 36″ x 22″.

"Pridmore" Pneumatic Rollover MOULDING MACHINE; type "EV"; two air cyls. 10¼″ dia. x 12″ str.; take boxes 2′ 6″ x 1′ 9″ app.

Very good land-type BABCOCK W.T. BOILER; 7,135 sq. ft. heating surface; 205 lbs. w.p.

***Write for "Albion" Catalogue.***

**Grams: "Forward." 'Phone: 23001 (10 lines).**
**ALBION WORKS, SHEFFIELD.**

## MISCELLANEOUS

FOR A NEW YEAR GOOD RESOLUTION we suggest this: "to order Foundry Supplies from William Olsen, Ltd., Hull."

### INGOT MOULDS.

WANTED.—Specimen quotations for economically supplying highly-finished cast-iron moulds for pouring white antifriction-metal branded ingots, preferable including necessary pattern work.—Box 528, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

**'Phone: 287 SLOUGH**

**SAND PLANT**

Herbert Whizzer, large size. **£48.**
Brealey Disintegrator, NEW. **£26.**
Pneumatic Riddles, Jackman type. **£9 each.**

**SANDBLAST PLANT**

BARREL PLANT by Tilghman, *as new*, 60″×40″. Price **£240.**
NEW 8′×8′ ROOM PLANT, complete. Price **£230.**
CAST IRON ROOM PLANT, 12′×9′, complete with 400 cu. ft. motor-driven compressor for A.C. current, in new condition. Cheap.
Several small complete barrel plants in stock.
Genuine Evans 10-ton Crane Ladle. Price **£35.**

***BUY FROM ME AND SAVE MONEY!***

**Alex. HAMMOND,** *Foundry Machinery Merchant,*
**14, AUSTRALIA ROAD, SLOUGH**

***Small Advertisements continued on page 62.***